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ELECTRICAL WORLD AND ENGINEER.

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NEW YORK, MAY 23, 1903.

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NATIONAL ELECTRIC LIGHT CONVENTION.

The remarkable growth which has attended the membership of the National Electric Light Association during the past year, and which will doubtless result in a very large convention next week, brings out the essential fact that while in the large cities there must be extensive systems of electric light and power, these will be relatively few as compared with the number of central stations as a whole. There are now not far short of 3,750 central station systems in the United States, and the Association has already drawn into its ranks at least 25 per cent. of the most progressive and successful of these. But it is obvious that a great many of them are not large, and from the nature of their environment never can be large. They will grow and prosper, but limitations of local area, population, wealth, industry, etc., will also be determining and restricting factors as to their business.

It is obviously to the best interests of the Association that these many smaller companies should be members, while the companies should be studied in return as to the make-up of the programme, the work, etc., so that they may derive benefit from the existence of the body. We are glad to note the attention paid by the officers to these two points, and from such meetings as those of Cincinnati last year and Chicago this year, believe we shall be able to date a new era in the usefulness and influence of an Association whose opinions and decisions can be made of great and beneficial weight in every community and in every part of the country.

Emphasizing our views in this respect, we have taken occasion in this issue not only to note appropriately the progressive work of that great system, the Chicago Edison Company, but to describe and illustrate some of the more typical plants of lesser size, which have met problems of their own and have shown what can be done in limited spheres of opportunity. There is, indeed, a great future for the smaller systems, regarded collectively, and we believe that a great deal of benefit can be derived from the study of the plants that must always be in the majority and which in themselves provide a fine outlet for capital and talent. Some of the details given in the articles we present are of a most interesting and encouraging nature.

THE UNION ENGINEERING BUILDING.

As will be noted from the reports elsewhere in this issue, the work is actively going forward of carrying out plans to give effect to the Carnegie gift of one million dollars for a union engineering building. The conference last week of the delegates of the four national engineering societies and the Engineers' Club was of a most harmonious and satisfactory character, and the resolutions were framed and adopted in a spirit that augurs well for the future of this great and noble enterprise. A good deal of hard work yet remains to be done, and we congratulate the American Institute of Electrical Engineers on the zeal and enthusiasm with which it is buckling down to its part of the responsibility imposed upon it by the gift. In selecting Messrs. Scott, Arnold and Wheeler as its representatives for the joint work, the Institute has made a wise choice which we believe events will fully justify; and in the prompt manifestation of generosity upon the part of individual members and electrical companies, we see warrant and assurance of success all along the line. While members will give to the extent of their

ability and public spirit, we are sure that the great electrical corporations drawing upon the Institute for their professional talent will recognize generally that this gift is also to them for their welfare; and, seeing this, they will be stimulated to meet Mr. Carnegie in his own wise and far-sighted endowment of the engineering professions and arts.

ELECTRICITY AND STEAM TRACTION.

Elsewhere in this issue we publish an abstract of Mr. De Muralt's article in the *North American Review* replying to that of Mr. Vanderbilt to which we directed attention some months ago. It seems to us that the reply is as good as the article that evoked it, and that electricity comes out very well from this latest analysis of its pretensions and performances in the field of traction. Meantime it is impossible to avoid noting the signs of the times that all make toward electricity and away from steam. It would be strange if they did not. The *New York Times* affords striking evidence last week. On Tuesday, discussing the Manhattan Elevated, it said: "The change from steam power to electricity is a success from every point of view. It has enormously increased the efficiency of the system, and in every way promoted in marked degree the public convenience." On the day following, it said, discussing the larger facilities given in Connecticut to the electrics, "The competition of the trolley is the most formidable the steam railroads have ever known, and it is only just beginning." It points out the inevitableness of electric transportation between New York and Boston, across the State. That is about enough for one week.

ELECTRICAL CONSOLIDATIONS.

The paper by Mr. Knowlton, which we publish in another column, excellently sets forth the gains which may sometimes be attained by consolidation and centralized management. Consolidation is the spirit of the times and has become so through its intrinsic advantages of one kind or another. Electric railway properties in particular often gain greatly in efficiency through wise consolidations of contiguous properties. In this case the gains are especially large and conspicuous, since connecting roads give new opportunities for mutual assistance and added public usefulness when placed under a single management. The facility which such combination lends to through routing of cars, the convenience of exchanging power and rolling stock and the more liberal system of transfers which becomes feasible; all these things tend to give new life to the united enterprise and to pave the way for even greater improvements. Common sense shows that two companies operating for the benefit of the same public in the same territory cannot carry on cut-throat competition without suffering thereby, and any sort of reasonable modus vivendi, from a rate agreement to actual union, will tend to improve the working conditions. And so we see a constant succession of coalitions of one sort or another and the results usually justify the wisdom of the union.

But there is another side of the question, which in the case of electric light and power companies must not be overlooked. The essential thing which makes ordinary combinations effective is physical union, the actual merging of two or more systems into one. Electric light stations are not like shoe factories, able to send a competing product to the other end of the country, and each is obliged to serve its own territory well or go out of business. And in such a condition we do not hesitate to say that the union of non-continuous properties into aggregations under a single management not absolutely and directly responsible to any one local public, is often of dubious advantage, save to the brokers who thereby inject a new flood into the united aqueous fluid of the component units. In cold blood the process practically means that the good properties lend a somewhat fictitious value to the poor ones at the expense of the public on whose patronage and good will prosperity ultimately depends, and often at the expense of honest investors who have looked upon the local plant as a sound conservative investment instead of a water bucket. We think that the alleged advantages from a centralized management are in such cases mostly moonshine, the fact being that the control is thereby removed from those who are in close touch with their customers and shuffled over into the hands of those whose only interest lies in squeezing out dividends to match imaginary assets. It is perfectly true that a big aggregation of plants may employ engineering talent of a high order, but it is notorious that it does not often do so, and frequently replaces competent local managers who are good business men and skilled engineers, by second-rate men who can be had cheaply, and who are held up from failure by occasional aid of an order which the original superintendent would have scorned to ask.

We believe, and we think most central station managers will agree, that the key to success in their business is an intimate knowledge of the local situation and its requirements, a complete grasp of the powers, needs and limitations of the plant, and a direct personal knowledge of the needs of the customers. No two plants are exactly alike and it is the man who knows his station as a small boy his pockets, who is in daily touch with the community, and does not have to plead with a distant office for three months before he can do what is necessary now, who will make a success of the enterprise. We believe particularly for stations of moderate size in the all-around man clothed with plenary powers by his board of directors. If he needs expert assistance he can get it, and he will need it far less frequently than the man whose only initiative is a futile appeal to powers who have not the slightest local interest or responsibility. Moreover, the public has interests at stake in this matter and will be heard from sooner or later in the premises. A plant may gain a better credit rating by selling out to a combination, but it is often at the expense of shouldering its proportion of a fictitious valuation from which it receives small benefits, and the public still less.

DIFFERENTIALLY WOUND TELEPHONES AS MEASURING INSTRUMENTS.

The great sensitiveness of the telephone has made that instrument available for delicate electrical observations, almost from the date of its first construction, and the telephone has been employed in a great variety of measuring instruments, even prior to its use in the Hughes' sonometer. The real difficulty with the telephone in such cases has been owing to its extreme sensibility. When inserted in the balance wire of a Wheatstone bridge operated by pulsatory currents, the symmetry of the four arms of the bridge has to be well nigh perfect with respect not only to resistance, but also to inductance, leakage and capacity, before the balance can be adjusted to give silence in the telephone. If any one of the four quantities just mentioned is not balanced among the bridge arms, the telephone will sing its note of discord, and usually no readjustment with respect to the three remaining quantities will silence the note due to the particular missing symmetry.

On page 884 of this number, Prof. Ho draws attention to the uses which can be made of the differential telephone for the purposes of measurement. The plan is by no means novel, since differentially-wound telephones have been used in the past for similar measurements, but the article is none the less useful for the development it gives to the subject. Just as in the case of the singly-wound telephone in a Wheatstone bridge, the differential telephone will only keep silent when the conductors compared are similar in the several respects already mentioned, and any marked dissymmetry in the two branch circuits through the instrument will only produce a sound minimum and not a sound-zero. Although the human ear is marvellously sensitive to sound zero, or the contrast between

silence and sound, it is very insensitive to the application of sound-minimum. Consequently, although, as Prof. Ho points out, the measurements are very sensitive, so that very small capacities or inductances may be measured and compared, there are marked limitations to the application of the method.

THE STEAM TURBINE.

Elsewhere we print an article describing the Curtis steam turbine so far as information has been available. What appeals particularly to the engineer in the steam turbine idea is the admirable mechanical simplicity possible in its practical realization, and in the Curtis machine this is exemplified in every mechanical feature. Indeed, one cannot but be impressed with the skill that has been shown in the mechanical design of the various parts, whereby the inherent simplicity of the turbine type has not been sacrificed while securing to the highest degree an efficient mechanical organization. This is particularly true in the adaptation of the turbine to the vertical shaft; the method of governing by multiple valves with electrical control; the manner of building the wheels, of controlling the pressure in the stages and in the design of the simple and efficient form of oil pressure bearing. The high order of ability exercised on the design of the mechanical details of the Curtis turbine can perhaps be no better illustrated than in the statement that the results obtained with the experimental machine finally fully embodying these details were so definite that orders with rigorous guarantees were without hesitation accepted for about a quarter of a million of horse-power before a single machine had entered into regular commercial use. Very much of the credit for this remarkable achievement is due to Mr. W. L. R. Emmet, to whom was assigned the responsibility of bringing the machine to the commercial stage, and who, together with his assistant, Mr. Oscar Junggren, is to be credited with many of the mechanical features of design that have so quickly assured the commercial future of the machine. A chapter giving in detail an account of this important phase of development of the machine would be of the greatest technical interest, and we hope that some day it may be written.

It is somewhat remarkable in view of the recent rapid development, that the commercial realization of the steam turbine idea was so long delayed. The first steam engine that history records was a turbine, and the kinetic principles involved were developed almost a half century ago by Thomson, Rankine and others, and later extended by Prof. Osborne Reynolds. It is true that the mechanical difficulties in the way have been very great, but that they were overestimated appears to be indicated by the manner in which they have in recent years been so largely surmounted by inventors. All forms and types of turbines, regardless of detail, depend for action upon principles that may be simply stated and easily understood. In the steam engine, the heat or molecular energy of the steam is manifested mechanically as pressure, and is transformed directly into the movement of the piston of the engine. In the steam turbine the molecular energy of the steam is transformed first into the energy of a stream of vapor moving in answer to a pronounced fall of pressure, and in which a high velocity of translation is thus developed. The energy of this moving stream is then transformed into mechanical motion through impact on moving vanes, as a consequence of which a part of the energy is transferred from the stream to the vanes. All forms and types of turbines, no matter what the detail, must be adapted to absorb in this general manner the energy of the stream. In the development of types, two broad lines have been followed. In one the purpose has been to transform as completely as possible, and in one operation, the heat energy of the steam into the mechanical energy of the escaping jet. This then impinges on the vanes of the turbine and gives up such a fraction of its kinetic energy as the conditions may determine. The De Laval turbine is a representative of this class. In the other general type, the two transformations are more or less continuous or distributed in stages throughout the machine. Thus the heat energy is partly transformed by expansion into the energy of the jet, and this into mechanical energy through action on the vanes. Then the same process is repeated until the largest possible fraction of energy has been thus transformed. In some cases the two transformations are in a measure carried on side by side, the heat energy being transformed by expansion into mechanical energy in the jet and then through action on the vanes into the motion of the turbine. The Curtis, Parsons and Rateau turbines are all of this general type, though differing in the general manner in which they fulfil the fundamental principles above referred to. There also seems to be no fundamental reason why under generally similar conditions there should be any essential difference in the steam economy of different types of turbines when working between the same initial and final conditions, and this appears to be borne out by economy tests of the two fundamental types.

In steam consumption several of the present commercial forms of steam turbines show economic performances somewhat less than those of the most efficient reciprocating steam engine, such as is designed for pumping service, though apparently fully equal to the best types of reciprocating engine used in electrical generation and superior to the ordinary engines employed in that service. A specific advantage claimed, however, is that there is very much less falling off in economy at fractional loads as compared with the best type of reciprocating engine, which, it is perhaps unnecessary to add, is a point of the highest importance in electrical generation. Moreover, there are the undisputed commercial advantages of considerable less cost of turbo-generator unit and less floor space occupied. Admitting that the steam turbine is commercially equal in economy to the best reciprocating steam engine at normal load, and superior in economy at fractional loads, yet the steam turbine cycle as at present utilized is less efficient than that of the reciprocating steam engine. In the working of steam, the turbine is free from loss by condensation and subsequent re-evaporation into the exhaust, there is less back pressure owing to freer exhaust, and there is more complete utilization of the expansive energy of the steam. These two latter points may be illustrated with reference to an ordinary indicator card by assuming that, working under the same initial and final conditions, the gains in the turbine cycle are represented by additional areas obtained by dropping the exhaust line of the indicator card and by adding a triangular area formed by a continuation of the expansion line beyond release. Moreover, the possibility of using a very high degree of superheat with the turbine still further extends its possible economic advantages over the reciprocating steam engine. Since, however, the two types are at present about on a par with respect to steam economy at normal load, it follows that the losses in working steam in the turbine are greater than in the reciprocating engine by an amount equivalent to the gain in the former through greater expansion, freer exhaust and using higher superheat. There is thus a large margin for the improvement of the steam turbine with respect to steam economy. At present little is known concerning the cause of losses in the steam turbine beyond the fact that a considerable proportion is probably due to friction from the presence of water of condensation, the amount of which condensation is necessarily so large that it can only partly be overcome by the greatest possible amount of initial superheating. The difficulties in the way of an analysis of the losses in the steam turbine are very great, but in view of the great commercial development the type is undergoing, we may expect many able minds to be brought to bear on the subject, with the probability of a progressive and final large increase in its steam economy.

Successful Conference on the Union Engineering Building.

In accordance with the call of Mr. C. F. Scott, a meeting of the nominated representatives of the five organizations named by Mr. Andrew Carnegie, in his gift of one million dollars to the four national engineering societies, and the Engineers' Club, for a building for their joint use and occupancy, was held pursuant to call, at the Engineers' Club in New York City, on the evening of Friday, May 15, 1903. There were present on behalf of the American Society of Civil Engineers, Messrs. Noble (President), Wilgus and Pegram; on behalf of the American Institute of Electrical Engineers, Messrs. Scott (president) and Martin; on behalf of the American Society of Mechanical Engineers, Messrs. Dodge (president), Charles Wallace Hunt and Hutton; on behalf of the Institute of Mining Engineers, Messrs. Ledoux (president), Dwight and Kirchhoff. On behalf of the Engineers' Club, Messrs. Kafer (president), Redding and Fletcher.

The meeting was called to order by President Kafer, of the Engineers' Club, and on motion Mr. Charles F. Scott, president of the Institute of Electrical Engineers, was elected chairman of the meeting, and Prof. F. R. Hutton, secretary.

The chairman opened the meeting by reference to the questions which were to be considered, and called on Mr. Redding for a presentation of some of its legal aspects. After a very full and most harmonious discussion, the meeting passed the accompanying resolutions unanimously. The secretary was directed to transmit a copy of the resolutions, as passed by the meeting, to each chairman of the constituent committee present, with a request that the latter should transmit the action of the meeting to the governing body of each respective organization. The conference then adjourned, subject to call of the chair.

Resolved, That this Joint Conference Committee recommend to the respective governing bodies represented at this conference, that the following resolutions be brought before the several organizations to be acted on:

Resolved, That (insert name of organization) unite with (insert the names of the other four organizations) or any of them, for the purpose of accepting the sum of $1,000,000 as a gift from Mr. Andrew Carnegie, for the purpose of erecting suitable buildings for occupancy by various societies of engineers and The Engineers' Club, on the sites secured for that purpose on the north side of Thirty-ninth Street and south side of Fortieth Street, west of Fifth Avenue, in the City of New York, in the State of New York.

And Resolved, further, That (insert name of organization) has a very high appreciation of this generous gift of Mr. Andrew Carnegie, and this additional evidence of his recognition of the engineering profession and his deep interest in the welfare of the national societies of engineers and The Engineers' Club.

And Resolved, further, That a site on the north side of Thirty-ninth Street shall be purchased and held by trustees, or otherwise, as shall be determined by the joint committee hereinafter mentioned for The American Society of Civil Engineers, The American Society of Mechanical Engineers, The American Institute of Electrical Engineers, and the American Institute of Mining Engineers, or by such of them as shall vote in favor of coming into this enterprise.

And Resolved, further, That a joint committee shall be created to be composed of three members of each organization that shall unite in accepting said gift of $1,000,000 from Mr. Andrew Carnegie; and that the governing body of (insert name of organization) shall elect three members of this organization to represent it on and be members of such joint committee; and that the governing body of (insert name of organization) shall have the right and power to remove any member of such joint committee who shall be elected by it and to elect any member of this organization to fill any vacancy that shall occur in such joint committee by reason of the death, resignation, refusal to act or removal of any member who shall have been elected by the governing body of this organization as a member of such joint committee.

And Resolved, further, That the character and internal arrangement of the building to be erected on the site on Thirty-ninth Street, shall be determined upon by the affirmative vote of at least two-thirds of all of such of the members of said joint committee as shall represent all of the organizations, other than The Engineers' Club, on such joint committee; and that the character and internal arrangement of the club building to be erected on the site on Fortieth Street, shall be determined upon by the affirmative vote of all of the three members of such joint committee who shall represent The Engineers' Club on such joint committee.

And Resolved, further, That said joint committee shall, by the affirmative vote of at least two-thirds of all the members thereof, select and employ an architect to prepare the plans and specifications for the building to be erected on the site on Thirty-ninth Street, and for the club building to be erected on the site on Fortieth Street; and shall also obtain proposals for the erection of both of such buildings; and shall have power to make and enter into such contract or contracts as shall be approved and authorized by the affirmative vote of at least two-thirds of all of the members of said joint committee, for the erection of both of such buildings; and shall have charge of the erection of both of such buildings.

And Resolved, further, That said joint committee shall continue in existence until all of the purposes set forth in these resolutions shall have been fully accomplished.

Institute Annual Meeting.

The annual meeting of the American Institute of Electrical Engineers was held in New York City, at the house of the American Society of Mechanical Engineers, on May 19, when there was an enthusiastic and overflowing attendance. As the result of the annual election, Mr. Bion J. Arnold was declared president, with 705 votes. The new vice-presidents are Messrs. Calvin W. Rice, W. S. Barstow and Ralph D. Mershon. The new managers added to the council are Dr. S. Sheldon, A. H. Armstrong, W. C. L. Eglin and Prof. G. F. Sever. Mr. G. A. Hamilton was re-elected treasurer and Mr. R. W. Pope secretary.

The report distributed showed total cash receipts of $30,181 and disbursements of $29,559, leaving a balance of $621. The inventoried property on hand totaled up $13,400. The Institute also has $16,285 in United States bonds and $2,006 in cash. The Library fund has also some $2,000 not yet brought into account, including $1,100 from Mr. C. O. Mailloux. It was shown that the Institute during the year had gained 680 new members, an increase of 44 per cent. With the applications pending and associates elected and to qualify, numbering 391, there is an immediate prospective total of 2,620 members. At the council meeting in the afternoon 140 new associates were admitted.

Acting on the adoption of the resolutions given elsewhere in this issue, the Institute accepted its share of the Carnegie gift of $1,000,000 for a union engineering building and cabled its gratitude to the donor, with pledges of its best efforts to realize the results now rendered possible. President Scott made an able and interesting statement with regard to the whole matter and then read a number of letters commending the gift and endorsing the union plan. One came from Mr. T. A. Edison. Others were from Past Presidents Kennelly, Hering and Anthony. All the writers felt that a great opportunity had come to the Institute and believed that its members would rise to the occasion and justify all that was expected of them.

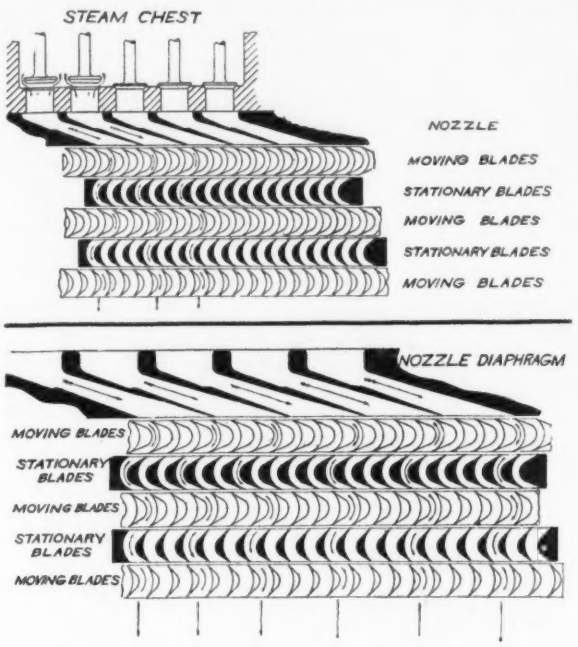
Mr. Scott stated that no beginning had yet been made of a proposed movement to raise a fund of $150,000 to $200,000 which should pay for the Institute's share of the land on which to erect the union building, but he read admirable letters from Prof. Elihu Thomson, who subscribed $5,000; Mr. Frank J. Sprague, who subscribed $2,000; Mr. J. G. White, who subscribed $1,000, with a contingent $1,500. He also stated that Vice-President Osborne, of the Westinghouse Electric & Manufacturing Company had authorized him to announce a contribution of $5,000 from that corporation. In the course of a brief, pithy speech, Mr. White expressed the hope and belief that while it would be the easiest thing in the world to get a mortgage on the property, the members of the Institute, aided by friends, by the great electrical capitalists and by the electrical companies, could raise outright the whole amount required in a short time. In the course of some remarks, Mr. Scott directed attention to the splendid work that had been done by Mr. Calvin W. Rive, the energetic chairman of the building committee, to whom a great deal of credit was due.

Papers were then read on "The Experimental Basis for the Theory of the Regulation of Alternators," by Mr. B. A. Behrend, and on "The Heyland Motor," by Mr. C. A. Adams, Jr. The discussion was brief on account of the lateness of the hour, and was participated in by Messrs. Behrend, Adams and W. L. Waters.

The Curtis Steam Turbine.

AS early as 1895 Mr. Charles G. Curtis constructed an experimental steam turbine to demonstrate the correctness of conclusions at which he had arrived in a long, careful study of the subject, that a prime mover of this type is not necessarily limited to enormous speeds, which assumed limitation had served for a century or more to keep all but a few of the more daring inventive spirits from attempting to develop the steam turbine as a competitor of the reciprocating engine. Several years ago a 600-kw Curtis machine was installed in the Schenectady works of the General Electric Company, the performance of which in regular shop service so fully and quickly verified the soundness of the principles upon which its design rested, both with respect to mechanical operation and steam economy, that the General Electric Company without hesitation proceeded forthwith to its commercial development for purposes of electrical generation.

This first practical machine was horizontal in form and recalled the compound engine in that the steam was worked in two structurally separate steam casings, exhausting from the first into the second and thence into a condenser. Most of the machines now being built are of the vertical form shown in the accompanying illustrations,



FIGS. 1 AND 2.— SCHEME OF TWO-STAGE TURBINE.

this construction enabling full advantage to be taken of the perfect balancing properties of this type of turbine and at the same time reducing to a minimum the floor space occupied. Doubtless in passing from one form to another, many changes in detail were found necessary or desirable, but concerning this there is at present no information. Indeed, few inventions have been so jealously guarded from the public, and it was not until several weeks ago that the mystery surrounding the machine was partially dispelled in a paper read by Mr. W. L. R. Emmet before the American Philosophical Society, of Philadelphia. This paper, which was printed in full in our issue of April 11, though meagre with respect to structural details, enters quite fully into the subject of the steam economy of the machine, compares the Curtis with the De Laval and Parsons turbines, and sets forth comparative theories of the operation of these several machines. In what follows, the mechanical details of the Curtis turbine will be more particularly considered in so far as the information available will permit, the reader being referred to the excellent paper by Mr. Emmet for a more general treatment.

With our present knowledge of the working of steam in the turbine and of the losses incident to the turbine cycle, any theories on the subject cannot be much more than conjectural. The difficulties in the way of analysis are apt to be accentuated by confusion of thought from the mind clinging to concepts formed with respect to the action of steam as it occurs in the reciprocating steam engine. Moreover, since pressure and velocity, and also change of pressure and expansion, are respectively correlative terms, and in the steam turbine we have to do with changes of velocity due both to impact and free expansion, and changes of volume due both to change of velocity and increase of containing volume, it is obvious how the mind in dealing with these and other terms under new and unfamiliar conditions may easily go astray. In what follows no theory of the action of the Curtis turbine will be stated, but in starting out the fundamental principles involved in the steam turbine in general will be reviewed.

A gaseous fluid, such as steam, in passing from a receiver at one

FIG. 3.—THREE-WHEEL STAGE, 500-KW TURBINE.

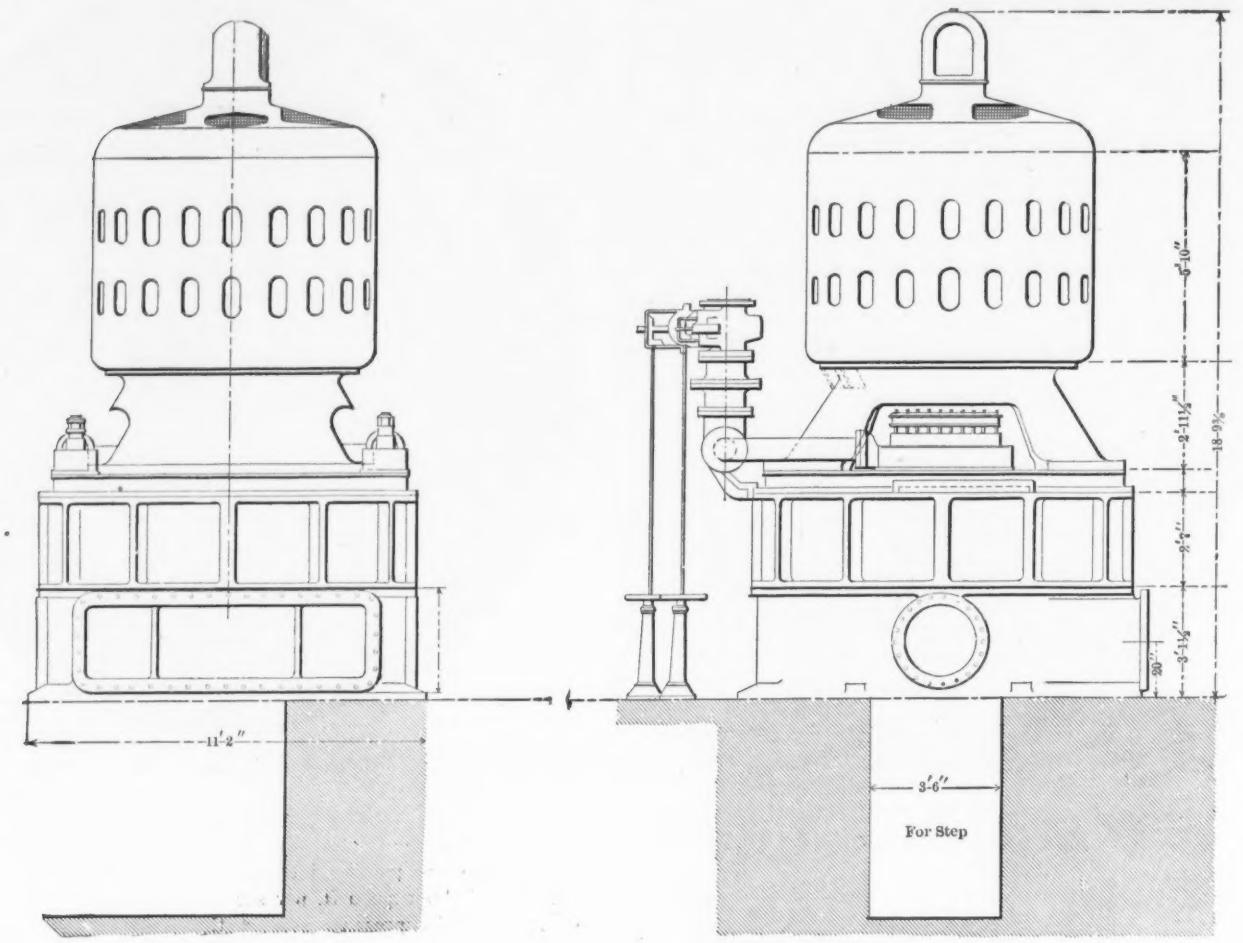
pressure into a receiver at another pressure, acquires a definite velocity due to the difference in pressure. For example, steam at 150 pounds pressure passing into a vacuum of 28 inches, will attain a velocity of about 4,000 ft. per second. A jet striking a surface will exert a definite pressure against that surface, the value of which

FIG. 4.—BUCKET WHEEL OF A 500-KW TURBINE.

in the case of normal impact is expressed by half the square of the velocity per second into the mass of fluid delivered against the surface per second. Should a surface against which such a jet impinges, such as that of a vane attached radially to a shaft, remain fixed, there will,

of course, be no energy delivered to the shaft; it is also evident that should the vane have the same velocity as the impinging jet, no energy will be delivered, since there is no exchange of velocity between the jet and the vane. The maximum amount of energy delivered will be when the vane has one-half (or more accurately, a little more than one-half) the velocity of the jet, for in that case, the remaining velocity in the jet after impact will equal the velocity of the vane and therefore be incapable of imparting further energy. Consequently, leaving aside any secondary actions, in order for a single-wheel steam turbine to act at maximum efficiency, its vanes should have a velocity of about 2,000 ft. per second working between the above limits of pressure—that is, not far from the velocity of a projectile from a modern piece of ordnance. It is thus readily seen that the problem encountered in the steam turbine is to extract from the steam the work due to its velocity without exceeding a moderate rate of revolution of the shaft carrying the vanes upon which the steam expends its velocity.

In the Curtis turbine the reduction of speed is obtained: 1°. By placing the vanes upon which the steam impinges at a relatively great



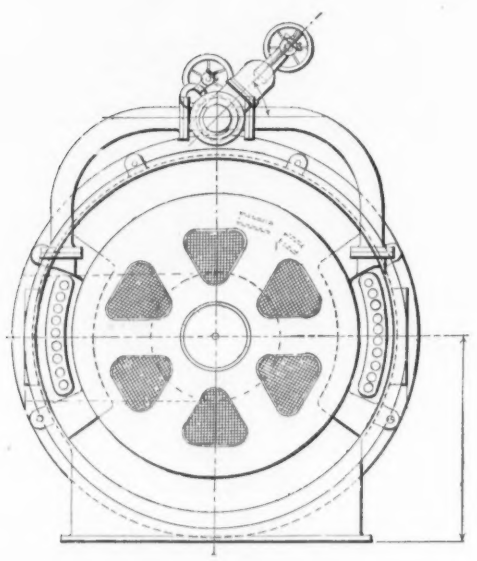


FIG. 5.—2,000-KW TURBINE.

radial distance from the axis of revolution, since for a given speed of peripheral velocity the revolutions will vary inversely as the radius. 2°. By the gradual absorption of the velocity of the steam at the periphery of a number of vane wheels; and instead of having all of these wheels in one chamber, they are divided into two or more groups of three or more wheels, contained in separate chambers, but secured to the same shaft. This provides for the development and parallel absorption of velocity in stages, the work being equally divided among the several stages.

Referring to the diagrammatic representations of Figs. 1 and 2, which apply to a two-stage turbine, and where the moving vanes or buckets are shown in outline and the stationary guides in black, the live steam enters through valves a multiplicity of nozzle-like passages, by which it is directed at a definite angle in jets against the blades of the first turbine wheel; from these blades the jets enter at a lesser velocity the guide passages below, where they are deflected at a proper angle to the blades of the second wheel, then pass into a second series of guides and finally to the third moving wheel—all three of the wheels, of course, being secured to one shaft. The steam then passes to a second chamber (Fig. 2), where, after undergoing the same action, it is finally exhausted into a condenser. In passing it may be remarked that the apparent obliquity of the horizontal lines in Figs. 1 and 2 is an optical illusion, the horizontal surfaces of the guides and wheels being, of course, parallel.

Since in the steam turbine the operation is the transformation of the energy of the steam jet due to its velocity, into useful energy at a shaft, steam pressure in its ordinary acceptance only enters in so far as it imparts velocity to the acting fluid. There is consequently an initial stage in which pressure is transformed into velocity, and here two factors are involved—the orifice and subsequent expansion previous to impact with the turbine vanes. In flowing through any orifice at maximum weight rate, an initial steam pressure

is reduced to about six-tenths, and further reduction can obviously be obtained by permitting free expansion between the orifice and turbine vanes.

Referring to Figs. 1 and 2, the orifice proper is at the contraction shown in the throat of the nozzle, beyond which there is an increase in area for expansion. Thus, if we start with a pressure of 150 pounds (gauge), this will be reduced at the nozzle to about 80 pounds (gauge); and if the area of the discharging end of the nozzle is 80 per cent. greater than the orifice or throat area, the pressure at the discharging end will be not far from 10 pounds (gauge). The above figures are only approximate, as the effects of surface friction and eddy currents are not taken into account.

In the Curtis turbine, the dimensions of the nozzle are so calculated that the steam when it strikes the blades in any of the stages has a pressure but slightly above the exhaust pressure, and this pressure in the passage through the wheels and guides is reduced by further expansion and in various ways to about the exhaust pressure. At this point the velocity should for maximum efficiency be substantially all extracted, the curvature of the buckets throwing the steam backward with a velocity equal to the forward velocity of the buckets.

The steam then passes through another set of nozzles into the second stage chamber, connecting with the condenser, and emerges from these nozzles with its velocity regenerated to be substantially equal to that generated in the first stage nozzle with a pressure but slightly above the condenser vacuum. After impact with the three wheels in this chamber, the steam is finally conveyed to the condenser.

Fig. 6 gives an external view of a 2,000-kw turbine, showing the magnets controlling the first stage valves contained in the steam chest beneath, which valves will be referred to later. It will be noted that the valve structure only occupies part of the circumference of the frame—in the case of this machine only about one-twelfth for each of the two groups in which the entire number is divided. In all machines the first stage nozzles only extend over about one-sixth of the circumference of the turbine wheels. In the 500-kw size they are all grouped together; in intermediate sizes they are divided into two, and in the 5,000-kw size into three, groups equally spaced. In all machines, the intermediate guides have the same circuferential length as the corresponding nozzle group. In the second stage, however, the nozzles and intermediate guides more often occupy an entire circumference.

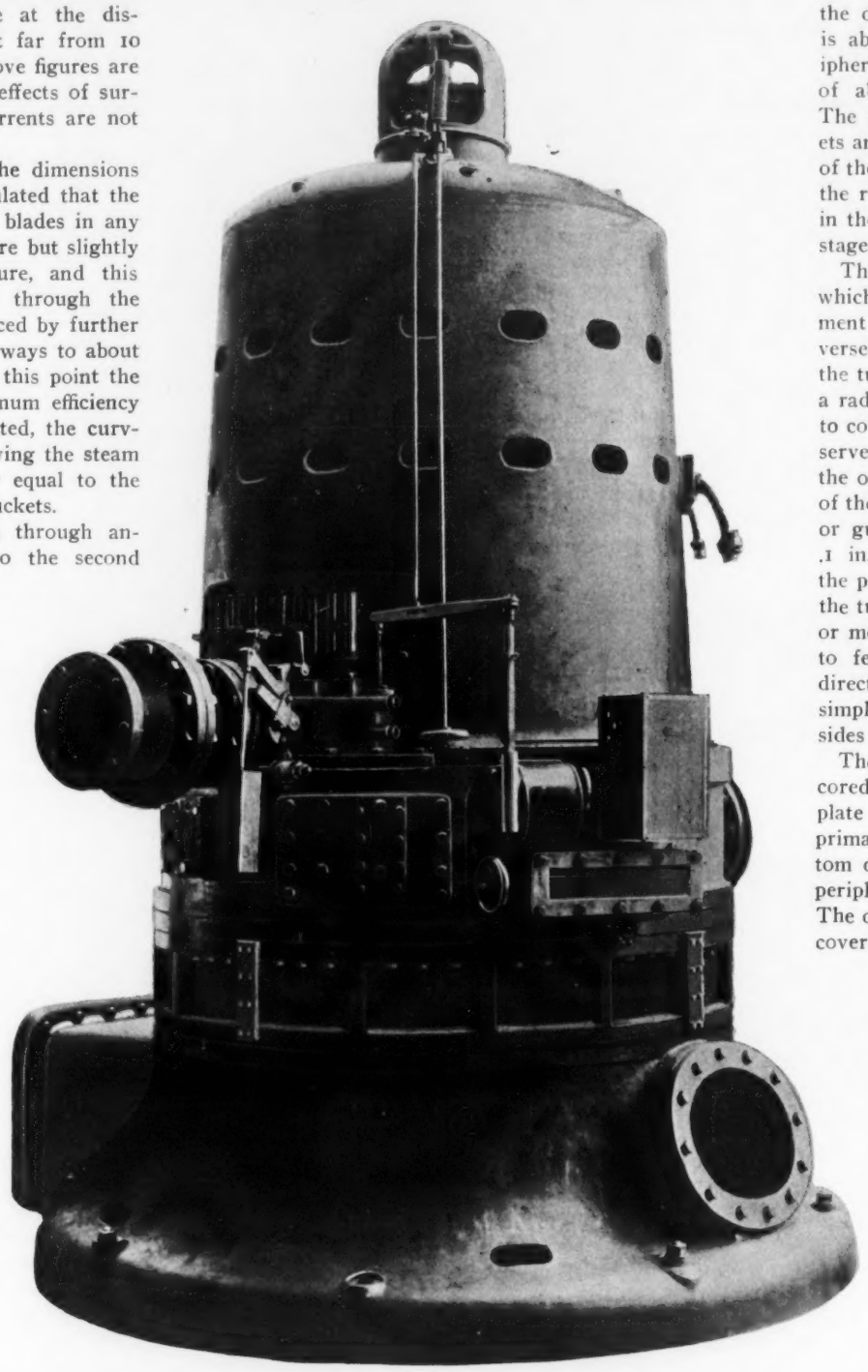


FIG. 6.—2,000-KW CURTIS STEAM TURBINE.

Figs. 3 and 4 show the wheels of a 500-kw turbine, and Fig. 7 segments of 1,500-kw wheels. In the case of a 500-kw machine, there are 280 vanes or buckets in each of the three wheels of the first stage, and 185 buckets in each of the three wheels in the second stage, the total number being thus 1,395. The passages of the intermediate guides have the same width and radial depth as the buckets which they serve. The curvature of the buckets and guides is different in the two stages. The buckets are cut by a special slotting machine in the ring of a solid steel disc or wheel about 1 in. thick, the tool being so guided that its cutting edge travels at each stroke over the exact curve to be reproduced. With this tool a complete wheel can be turned out daily. After the buckets are cut, a band is riveted about the periphery of the wheel, as shown in Fig. 8. The diameter of a 500-kw wheel to the outer edge of the buckets is about 4½ ft., giving a peripheral speed at this diameter of about 420 ft. per second. The radial depth of the buckets and guides in the first wheel of the first stage is about ¾ in., the radial depth of the buckets in the first wheel of the second stage being about 1 in.

The intermediate guides, which resemble the wheel segment of Fig. 8, but with reversed curvature, are bolted to the turbine outer case and have a radial depth merely sufficient to cover the buckets which they serve. The clearance between the opposing horizontal surface of the wheels, and of the nozzle or guide plates is from .04 to .1 in. The clearance between the periphery of the wheels and the turbine case may be an inch or more, since there is nothing to fear from leakage in that direction, the pressure being simply the shell pressure on all sides of the wheel.

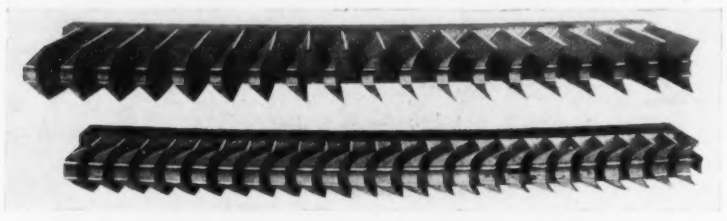
The so-called nozzles are cored or cut passages in a cast plate which, in the case of the primary stage, forms the bottom of a steam chest over the periphery of the turbine wheel. The openings to the nozzles are covered by disc or poppet valves, there being one valve for each pair of nozzles. These valves are horizontally placed in the larger turbines. A valve is seated or opened by the action of steam on a piston on the valve stem, the steam being admitted or exhausted by a small needle or pilot valve actuated by a magnet. Current is supplied to the magnets from circuits connected with a controller, the current being taken from the exciter bus-bars of the generator operated, the amount of which is regulated by a rheostat, shown in Fig. 6. The number of magnet circuits closed at the controller—and consequently the number of valves held open—is regulated by a centrifugal governor at the head of the shaft, the connections of which with the controller is shown in the same figure. The above is the electrical type of governor.

The size and number of nozzles are fixed by the quantity of steam required to run a machine when working non-condensing. When working condensing only about half of the nozzle valves are held open at full load, a machine thus having 100 per cent. overload capacity when exhausting into a vacuum. As implied above, the governing is effected by cutting in or out magnet circuits, thereby

increasing or reducing the number of nozzles in service. The governor may also be independently controlled from a distance, as from a switchboard in starting up and in synchronizing, by means of a hand wheel for the 500-kw size and a small motor for the larger turbines. There is also an emergency shaft governor between the turbine and generator which trips and closes a butterfly valve in the main steam inlet. There is also connected with the governor mechanism a balanced throttle valve in the steam path of the first pair of nozzles, its connections being such that it must be fully open before the governor can move the controller to admit steam to another pair of nozzles, and vice versa; the effect of which is to obviate rapid alternate opening and closing of the magnetically operated valves, as would otherwise occur in keeping the speed constant. The governor is designed for 2 per cent. speed regulation between no load and full load, with a momentary variation not exceeding 4 per cent.

The nozzles of the second stage cover, as stated before, an entire circumference in some machines, and are secured to the diaphragm separating the first from the second stage. The nozzle openings are adjusted by a register ring which may be rotated through a small angle, covering or uncovering the nozzle openings sufficiently to maintain the necessary pressure relation between the two stages, or to shut off the second stage when the turbine runs non-condensing. This adjustment when once made remains permanent for an approximately fixed condition of load. The first stage casing is provided with a relief valve to guard against any undue pressure therein.

One of the important features of the Curtis turbine is the extreme simplicity of the shaft mounting. Owing to the manner in which the steam acts on the bucket wheels, the vertical pressure component can be very exactly balanced. As actually designed, the only pressure on the step of the vertical shaft is that due to the weights it carries. The step arrangement is simplicity itself, consisting of a



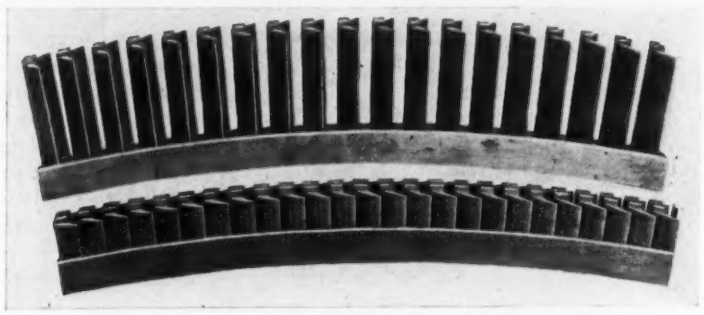


FIG. 7.—SEGMENTS OF 1,500-KW TURBINE WHEELS.

cast-iron shoe secured on the foot of the vertical shaft over a similar stationary shoe. Oil at a pressure of 250 pounds per square inch or more as needed, is forced through a hole in the center of the lower shoe, then passes radially to the periphery of the shaft shoe, then upward to a babbitt guide bearing and finally back to the pump. In addition to the lower guide bearing there is another bearing between the turbine and generator and a third above the latter. In connection with the oiling system is an arrangement by which the turbine is automatically shut down in case of failure of oil supply.

Following are speed and frequency data of the units thus far designed:

Kw.	Rev.	Frequency.	Kw.	Rev.	Frequency.
500	1800	60	2000	750	50
1500	800	40	3000	600	60
1500	900	60	5000	500	25
2000	750	25	5000	514	60

It is calculated that the steam consumption of a 5,000-kw, two-stage vertical unit will be 19.75 pounds per kw-hour. While this is a slightly greater consumption than has been reported for the most efficient types of reciprocating engines, such as those for pumping service, to be equitable, comparisons of steam consumption should be made between machines designed for the same service, and it is well known that in the design of reciprocating engines for electrical generating service, sacrifices in economy of steam consumption are entailed. But a remarkable intrinsic advantage of the

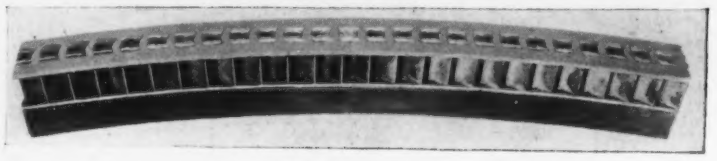


FIG. 8.—SEGMENT OF WHEEL RIM.

steam turbine brought out in Mr. Emmet's paper is the comparatively slight dropping off of efficiency at partial loads—a point of the utmost importance in electrical generation. The guarantee for a 500-kw unit is 20.5 pounds of steam per kw-hour at full load and 23 pounds at half load, under a boiler pressure of 150 pounds and a vacuum of 28 inches. For an extended discussion of the steam economy of the Curtis turbine, including a consideration of the superior effect of superheating and of the use of a vacuum, the reader is referred to Mr. Emmet's paper in our issue of April 11.

A. I. E. E. Membership.

The total membership of the American Institute of Electrical Engineers on May 1, 1902, was as follows:

Honorary Members		2
Members		405
Associates		1,142
Total May 1, 1902		1,549
Elected prior to May 1, 1902, and since qualified		16
Elected May 1, 1902, to April 30, 1903, and qualified		695
Restored to membership		1
		2,261
Total deaths	9	
Total resignations	12	
Dropped as delinquents	11	32
Grand total, April 30, 1903		2,229

The membership April 30, 1903, was classified as follows:

Honorary members	2
Members	417
Associates	1,810
Total	2,229

The gain in membership during the year is 680, an increase of 44 per cent. As there are now applications pending and associates elected but not yet qualified to the number of 391, there is an immediate prospective total of 2,620 members.

The associates elected during the year, May 1, 1902, to April 30, 1903, and their present status is as follows:

Qualified and now associates	695
Died before qualification	1
Elections cancelled	4
Not qualified on April 30	165
Total elections	865

Resignations have been received and accepted during the year from the following members and associates who were in good standing:

Members—Brown Ayres, W. E. Geyer, Henry Jackson. Associates—Frank Broili, Harry A. Gillis, F. A. Greenwood, A. F. McKissick, H. N. Sweet, Walter Rutherford, H. Schreiter, J. C. Finney, Paul Bonynge.

There have been the following deaths during the year: Member—Charles T. Child. Associates—Henry Norton, E. Rathenau, W. F. D. Crane, Max T. Steinle, F. J. Folk, E. A. Darling, I. D. Parsons, Sidney H. Short.

The Editing Committee finds that the increased quantity of material has made necessary the division of the bound *Transactions* into semi-annual instead of annual volumes. The discussions of the branch meetings add to the volume of material and to the labors of the Editing Committee. When discussions upon the same papers take place at the different branches, the same ideas are in many cases repeated, making a careful revision of the discussions necessary in order to prevent repetition while retaining all that is new and valuable.

Recent Development of the Chicago Edison and Commonwealth Electric Systems.

SINCE the last National Electric Light Convention in Chicago in 1900, the growth of the two great allied central station lighting companies of Chicago, the Chicago Edison Company and the Commonwealth Electric Company, has been almost beyond belief. At that time the distribution of direct current from rotary converter sub-stations had but fairly begun, and in the past three years the number and capacity of these sub-stations has been enormously increased, as will be seen from the figures given later. The chief interest to the central station man, however, centers in the Fisk Street Station, which is the great power house now under construction, designed for the use of 5,000-kw Curtis steam turbine units. When the order was placed little was known about this turbine, and it was a radical move on the part of the Commonwealth Electric Company, but the Chicago Edison Company has always been one of the leaders in central station practice. When it was decided to begin the construction of a second large generating station (since the limit of the capacity of the Harrison Street station, which was put in operation ten years ago, has been reached) it was realized that it would be desirable to design a power house for the production of electrical energy on a much larger scale and with much larger units than heretofore. It is unnecessary to recount the advantages in simplicity, economy on light load, saving of first cost and saving of floor space accomplished by the steam turbine.

The Curtis turbine, which is described elsewhere in this issue, is now comparatively well known in the engineering field. Such was far from being the case, however, when the order of the Chicago Edison Company was placed, and no little credit is due to the management of this company in taking the initiative and planning its great station for the use of this steam turbine. It should not be thought, however, that the company was unwise enough at the outset to commit itself irrevocably to the use of a device which had never had actual commercial trial in as large units as those for those for which the station was planned. The turbine room, by widening ten feet, could be easily turned into an engine room for reciprocating engine units. This was something that could easily be done with the amount of space at the company's disposal at this power house site, and was nothing more than a resonably conservative move at the time the turbine order was placed, for at that time of course much less was known as to the actual performance of the Curtis steam turbine than now. It was expected that the first 5,000-hp unit would be in operation by this time, but unforeseen delays have made this impossible.

The location of the new Fisk Street station, where the steam turbines are to be installed, is an ideal one for a large power house in many respects. As shown in Fig. 1, it is on the Chicago River, not far from the corner of Center Avenue and Twenty-second Street, or, to be more exact, at Fisk and Twenty-second Streets. It is surrounded on three sides by water, on the south by the Chicago River, and on the east and west by slips. These slips not only facilitate unloading of coal from barges, but also make it very convenient for condensing water. The Chicago River flows from east to west into the drainage canal with a good current. Condensing water will be taken in at the east slip and discharged into the west slip, so that there will always be a cool supply of condensing water at a minimum cost for piping. The level of the river being practically constant, no provisions have to be made for variation in the height of the stream, as is so frequently the case in the design of condensing plants. The company also owns, as is seen in Fig. 1, land on the south side of the river, opposite this station, the total area being 14 acres. A siding from the Chicago & Alton Railroad enters this land south of the river, and a siding of the C. B. & Q. Railroad fore, two rail sources of coal supply, as coal can be taken across the river in barges from the Chicago & Alton siding. The lot south of the river affords room for considerable coal storage, as it does also the lot on which the power station itself is located. The necessity for ample terminal and storage facilities for coal for a station of such size using two trainloads a day is very evident.

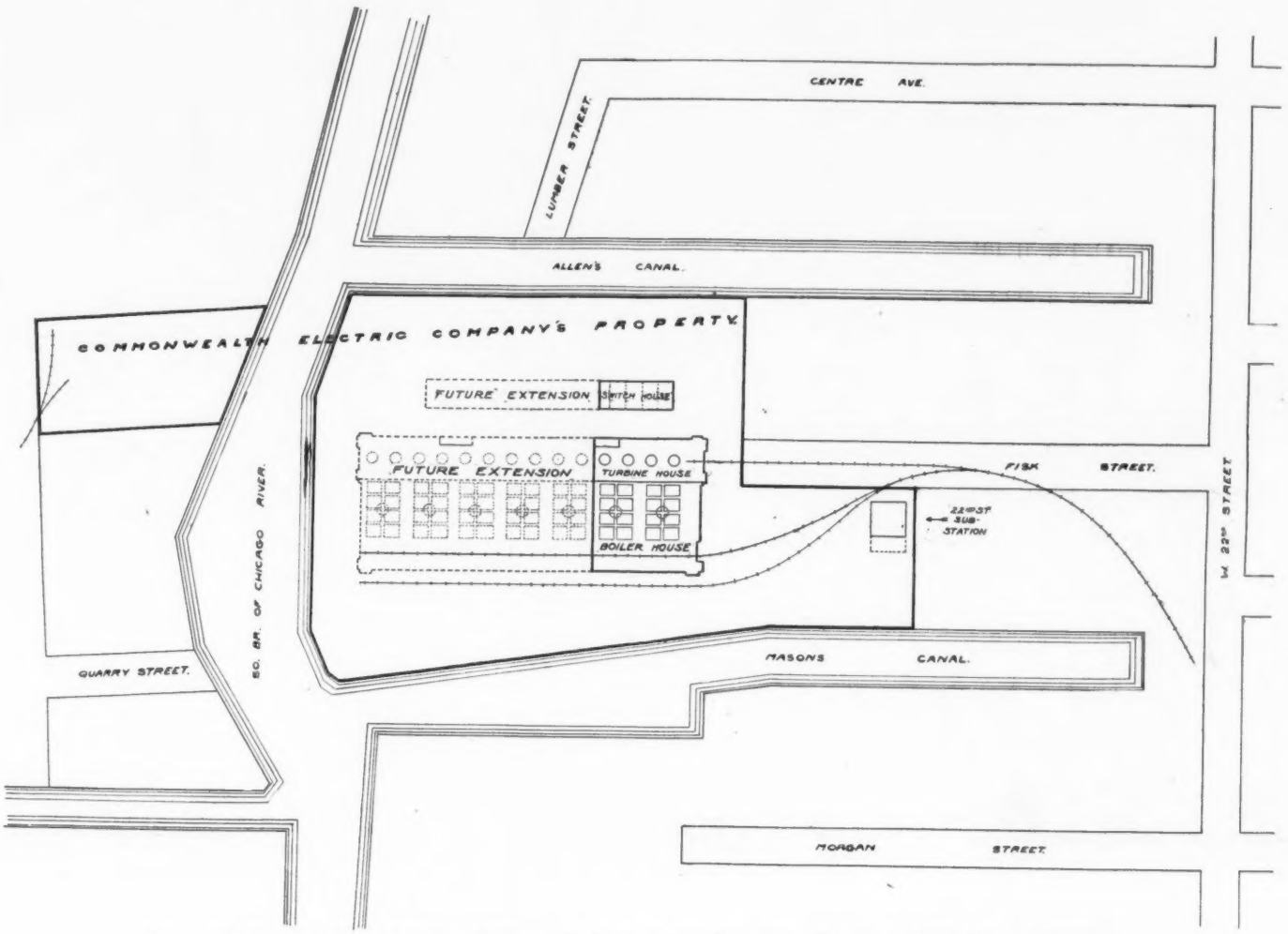


FIG. 1.—MAP OF COMMONWEALTH ELECTRIC CO.'S PROPERTY SHOWING PLAN OF FISK STREET STATION.

This Fisk Street station, as seen on the map (Fig. 10) is 3½ miles from the electrical load center of the city, which center is within three blocks of the corner of Clark and Monroe Streets. Real estate conditions in connection with this power station are radically different from those in New York, where the large power stations have been built. In other words, this company was able to obtain real estate considerably cheaper than it could be obtained for the large New York stations, and the saving of ground space was not in this Fisk Street station as great an object as in the large New York power houses. This is a point which should be remembered in considering the design of this station, which is briefly described later. The station occupies more ground space per kilowatt than the New York stations, but figured on the basis of cubic capacity, the Fisk Street station gives a very high output per cubic foot.

As seen by Fig. 1, the station is built in 5,000-kw sections. The present building is planned for four 5,000-kw steam turbines, one of which is about to be installed. The ultimate capacity is 14 units of 5,000 kw. Each steam turbine forms a section of the power house, together with a battery of eight Babcock & Wilcox boilers to supply it. Each battery of eight boilers is placed at right angles to the long way of the power house, which is a practice considerably at variance with previous power house design. The reason for this is the great amount of boiler capacity required to supply a single 5,000-kw steam turbine. In designing the power house, it was, of course, necessary to arrange it so it could be enlarged unit by unit, section by section, on a symmetrical plan. The boilers to supply one turbine should, therefore, occupy the same space measured the long way of the power house as the steam turbine unit. The only way, therefore, of getting boiler capacity sufficient to drive one of these turbines into the width of power house section required by the turbine itself, was to arrange the boilers as was done here. Of course by making additional floors to the boiler room, as has been done in the large New York stations, and putting the boilers in tiers one above the other, the old arrangement of placing the rows of boilers the long way of the power house might have been preserved, but it was not thought that considering safety, reliability and the cost of real estate, that a boiler room of several stories was here justified.

Each battery of eight boilers will be supplied by its own coal-conveying apparatus. This coal-conveying apparatus will receive its coal from a crusher hopper, which crusher hopper will for the present be supplied from dump cars, although this latter is not the permanent arrangement contemplated. Each 5,000-kw section of the power house, with its 8 boilers, will have storage capacity of about 1,000 tons of coal. The boilers are equipped with Babcock & Wilcox chain grate stokers and with superheating coils, as it will be possible in this station, by the use of turbines, to take full advantage of chances for economy, by superheating the steam, as could not be done with reciprocating engines requiring the lubrication of pistons and valves. The stacks of this power house will be of steel, 205 ft. high and 18 ft. in diameter. The dimensions of the completed power house building are 600 x 230 ft. The turbine room spanned by the crane is 62½ ft. wide. The coal is unloaded under a part of the building having open arches.

The John A. Mead coal-conveying apparatus, with McCaslin buckets, has been selected. There will be an auxiliary fine coal hopper under the link grates to catch the fine coal which sifts through this type of grate. From this hopper the coal is taken back from the main hopper by conveyers. The boiler room floor is considerably above the level of the turbine room floor, as a basement 12 ft. high is under the boilers, and there is only two ft. difference in level between this boiler room basement and the main turbine room floor. Each battery of eight boilers will feed into a common header, and this header is below the boiler room floor, and from this header the steam piping will run on a level to the steam turbines. The boilers will be operated under 175 pounds pressure, with 150° superheating of steam. The steam piping for each unit is to be run in separate chambers in the basement, thus carrying out in the steam end the same idea of subdivision to prevent interruption that is being carried out in the electrical end. Electrically-operated steam valves will be used to enable valves to be closed from a distance in case breaks or leaks in the steam piping prevent men from entering the pipe tunnels to close the valves by hand. Alberger's surface condensers will be used in connection with the steam turbines.

About 8 per cent. of the space in the Fisk Street station is devoted to coal storage. A switch track enters one end of the turbine room, so that heavy machinery can be taken by the traveling crane directly from the car. Of course, these generating units will not have anything like the heavy parts of a slow-speed engine-driven generator of the same capacity, as these 5,000-kw units will run at a speed of 500 r.p.m.

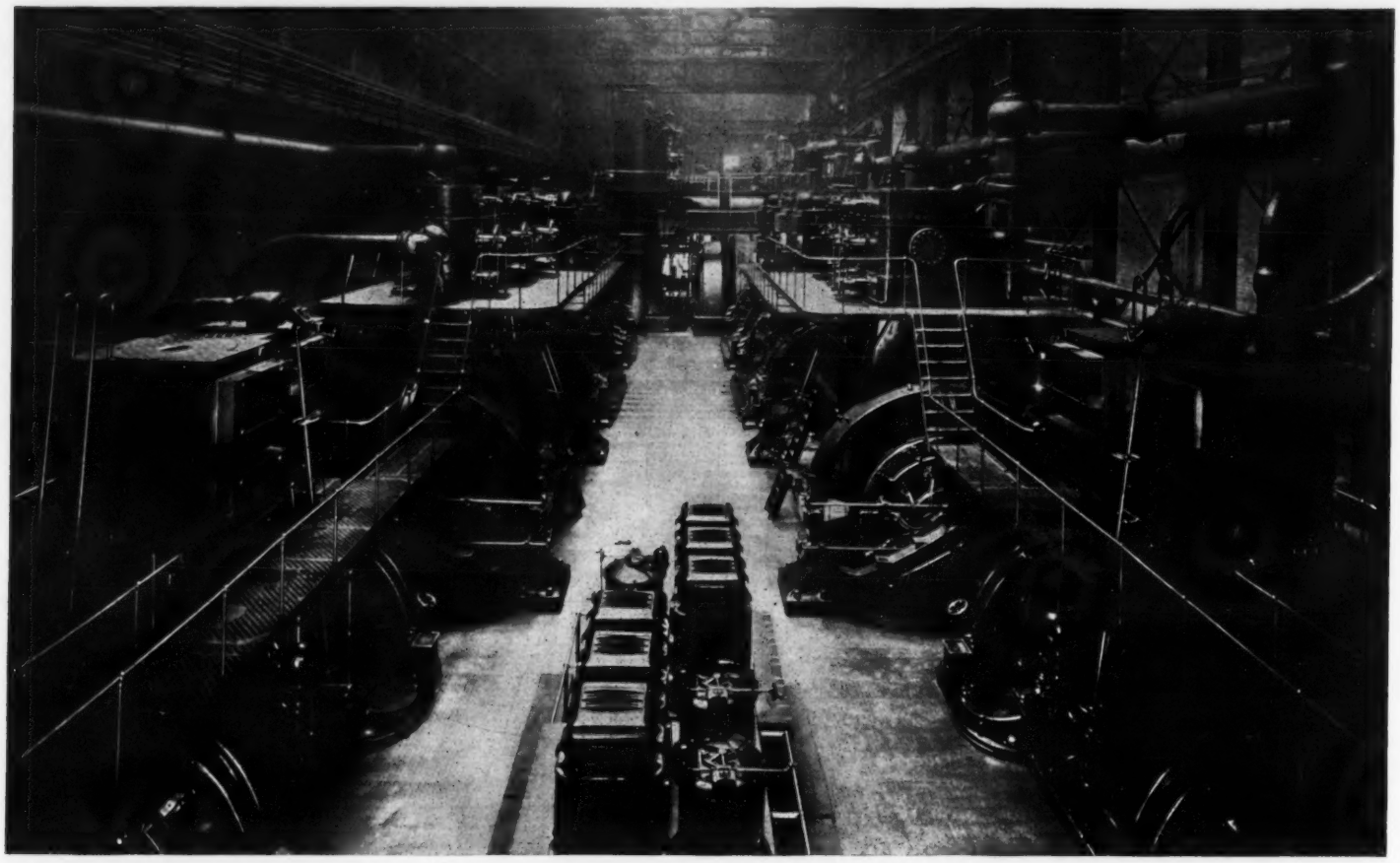


FIG. 2.—GENERAL VIEW OF HARRISON STREET STATION.

FIG. 3.—WEST MADISON STREET SUB-STATION.

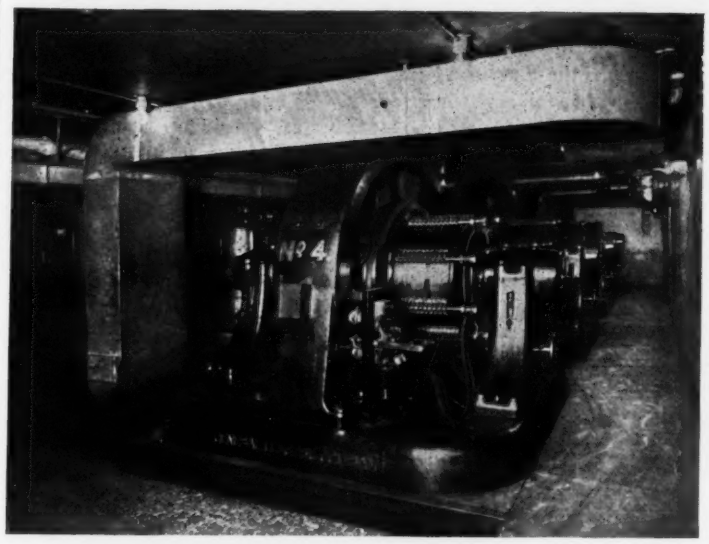


FIG. 4.—FOUR ROTARIES, DEARBORN STREET.

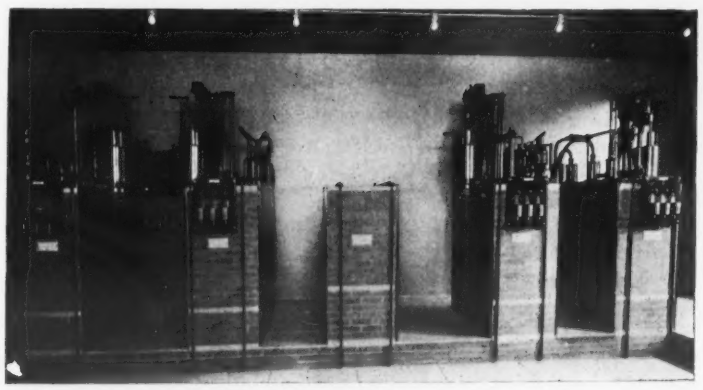


FIG. 5.—HIGH-TENSION SWITCHING APPARATUS.

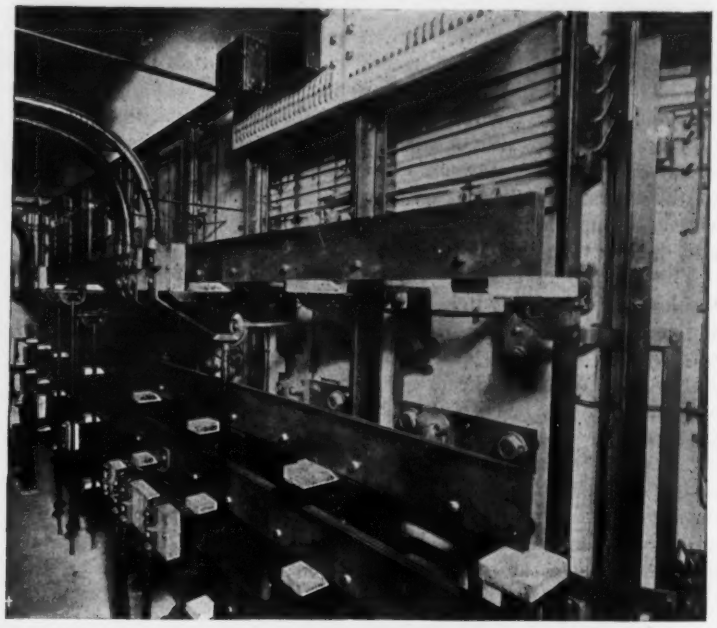


FIG. 6.—REAR OF SWITCHBOARD SEDGEWICK STREET SUB-STATION.

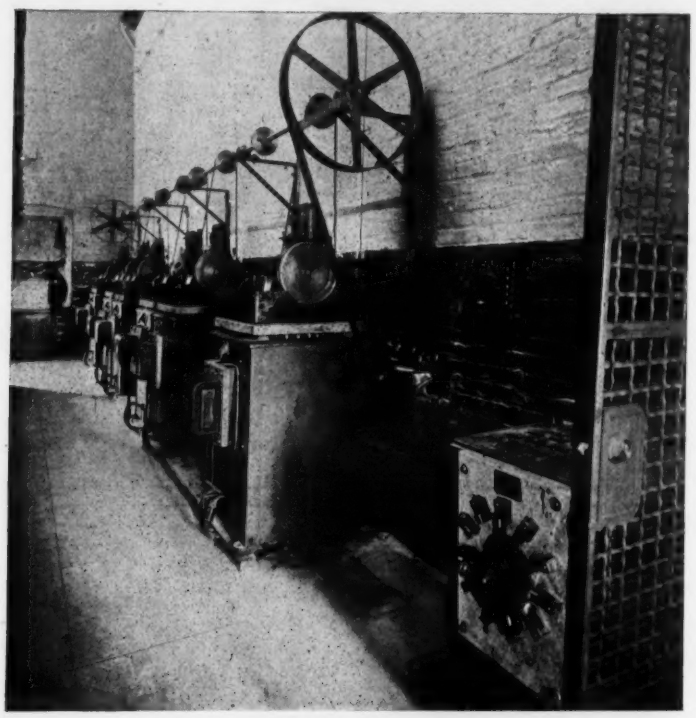


FIG. 7.—INDUCTION REGULATORS, MADISON STREET SUB-STATION.

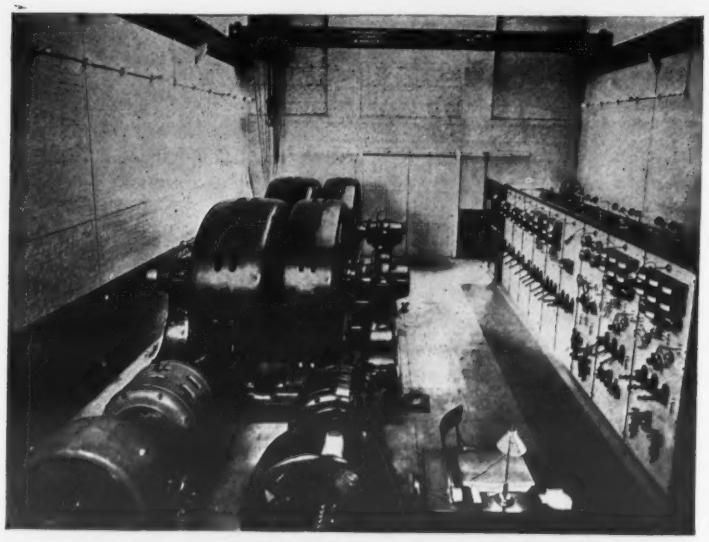


FIG. 8.—INTERIOR VIEW OF WEST MADISON STREET SUB-STATION.

All the generators in this station will give 3-phase, 9,000-volt, 25-cycle currents, and will be star-connected, with neutral point grounded. The reason low-frequency generators were chosen for this station is that by far the greater part of the company's output is now and probably always will be converted into direct current at rotary converter sub-stations. The lower frequency is better adapted to the operation of rotary converters, as the 25-cycle rotary converter is a much more satisfactory piece of apparatus to construct and operate than the 60-cycle.

The controlling board is to be located in the turbine room, but the high-tension oil switches themselves will be in a separate building about 50 ft. away. This building will contain all the high-tension oil switches and high-tension bus-bars, separated from each other by brick partitions. The principle of isolating one generating unit from another will be carried out as fully as is practical in the switching arrangements. Even the low-tension, direct-current controlling circuits between the controlling board and the high-tension oil switches in the switch house will be run in separate compartments. Each unit will feed directly a certain set of high-tension feeders. By means of a transfer bus, feeders can be transferred from one unit to another, or generators can be operated in parallel. The general

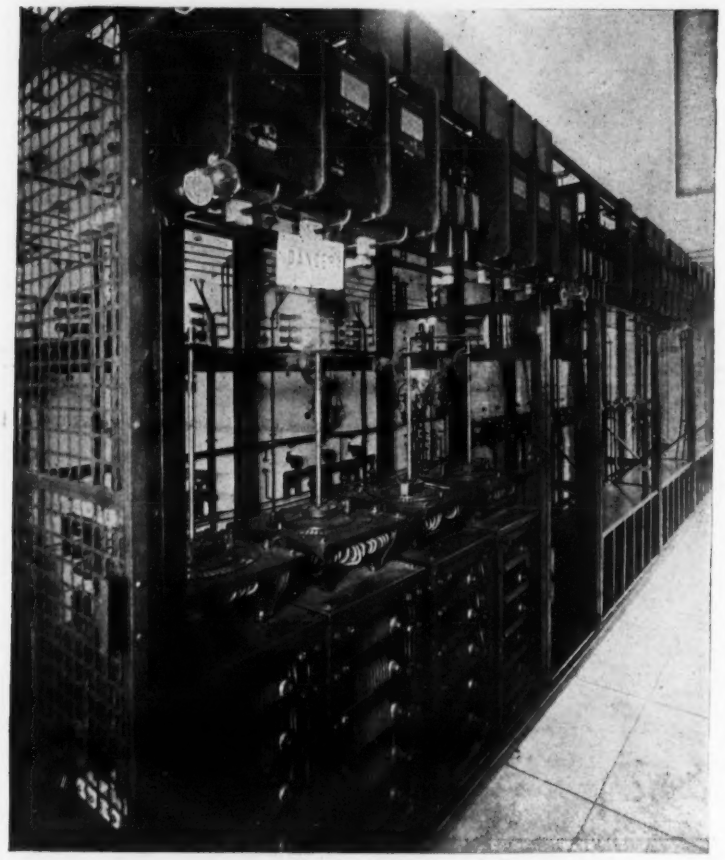


FIG. 9.—REAR OF SWITCHBOARD, WEST MADISON STREET SUB-STATION.

scheme is to have each generator so it can be connected to a short section of feeder bus through an oil switch, or it can be connected to a main bus. The different short feeder bus sections can be tied together by oil switches, and the main bus is also sectioned by means of oil switches.

Only the instruments absolutely necessary for operation will be put on the controlling board in the station. Those not essential to operation, as the recording wattmeters and extra ammeters, will be put in the switch house, thus saving considerable low-tension control switchboard wiring, and simplifying matters for the switchboard attendant. Direct current for the operation of switches and other small apparatus requiring direct current will be supplied from a erty near Twenty-second Street, which is to be known as the Twenty-second Street sub-station. This sub-station being near the border line between alternating-current and direct-current territory, will supply both alternating and direct current for distribution.

The switch house is to be 50 ft. wide by 460 ft. long, ultimately, its length depending, of course, upon the length of the power house building. The basement will be devoted to the isolated compartments for the high-tension bus-bars and connections. On the first floor will be the oil switches and instrument panels containing such instruments as are not needed on the operating board. On the second floor will be the quarters for the turbine room men.

In the new power house considerable attention will be given to the comfort of the employees. Reading rooms with current technical periodicals, lockers and baths, are among the comforts that are to be provided to increase the efficiency of the operating force.

The turbine room will be finished on the interior with glazed brick and terra cotta. There will be a gallery on both sides of the turbine room at about the level of the boiler room floor. The exterior of the building is finished in red pressed brick.

Although the Fisk Street station is attracting more general interest the country over at the present time than any other work recently done by the Chicago Edison Company, there are many other features in its recent development worthy of note. Most of these have been already described, either by special articles in these columns or by abstracts of papers presented by the officers of the company to various technical societies. As a matter of history, a few facts in regard to the growth of the Harrison Street station, which is the company's principal generating station at present, illustrate the remarkable expansion of the central station business in Chicago.

Ten years ago the Harrison Street station was just being started in operation, four 400-kw generators being the first equipment to supply current, although there were under installation in that station in 1893 four 400-kw generators and eight 200-kw generators, or a total of 4,800 kw. The generators were direct current, arranged in pairs on vertical engines. In 1900, at the time this station was described in the ELECTRICAL WORLD AND ENGINEER, May 19, 1900, just previous to the last electric light convention in Chicago, the equipment consisted of eight 200-kw and twelve 400-kw generators, or a total capacity of 5,200 kw. Some of these generators in 1900 were of the double-current type, giving either alternating or direct current. In 1903, at the present time, there are in this station eight 200-kw generators, twelve 400-kw, one 2,500-kw, one 3,100-kw, two 1,000-kw, and one 1,800-kw, or a total capacity of 15,600 kw. Fig. 2 shows the main engine room as it is at present.

Not only is the Harrison Street station fully loaded, but it is necessary at times of fall and winter peak loads to operate the steam plants in the three combination sub-station and subsidiary steam plants which the company was operating three years ago, as well as the Washington Street steam plant of 4,600 kw in direct current. These steam plants, to be sure, are put in service for only a few months each year, with one shift of men to carry the heavy load which comes in November and December. As they are already installed and of very little scrap value, it is not considered that it would pay to entirely abandon them and to invest enough money in modern generating plant and sub-station apparatus to carry the peak loads which the steam plants carry for a short time each year, even though the steam plant efficiency be low. By next fall these two companies will have 24,000 kw in rotary converters and 4,000 kw in frequency changers installed in its sub-stations. The maximum load in 1902 was 29,080 kw, of which 24,000 kw was direct current. The storage batteries carried during the maximum load mentioned 20 per cent. of the direct-current load. The connected load of the two companies is the equivalent of 1,652,000 16-cp incandescent lamps.

As was noted in the ELECTRICAL WORLD AND ENGINEER for November 29, 1902, in an article on "The Randolph Street Sub-station and the Development of the Chicago Edison System," there has been a great increase in the number of rotary converter sub-stations giving direct current to the Edison 110-220-volt network. Some of these sub-stations in the basements of modern fire-proof office buildings. Fig. 4 is the interior view of one of these at 114 Dearborn Street. The Harrison Street station was laid out as a direct-current plant, but as the direct-current district increased in size and the load density in all parts increased, it naturally was the most economical move to begin the establishment of rotary-converter sub-stations wherever the load seemed to demand it within the Edison district. At the time of the last convention in 1900 there were three of these direct-current sub-stations, and there are now, including those under construction, seventeen such sub-stations.

Outside of the Edison district, in the district served by the commonwealth Electric Company, a 3-phase, 4-wire system is used, with grounded neutral and 2,300 volts between any phase and ground. This alternating-current distribution is at 60 cycles. Part of this 60-cycle current is generated and distributed direct from steam plants, but there are a number of sub-stations at which 25-cycle,

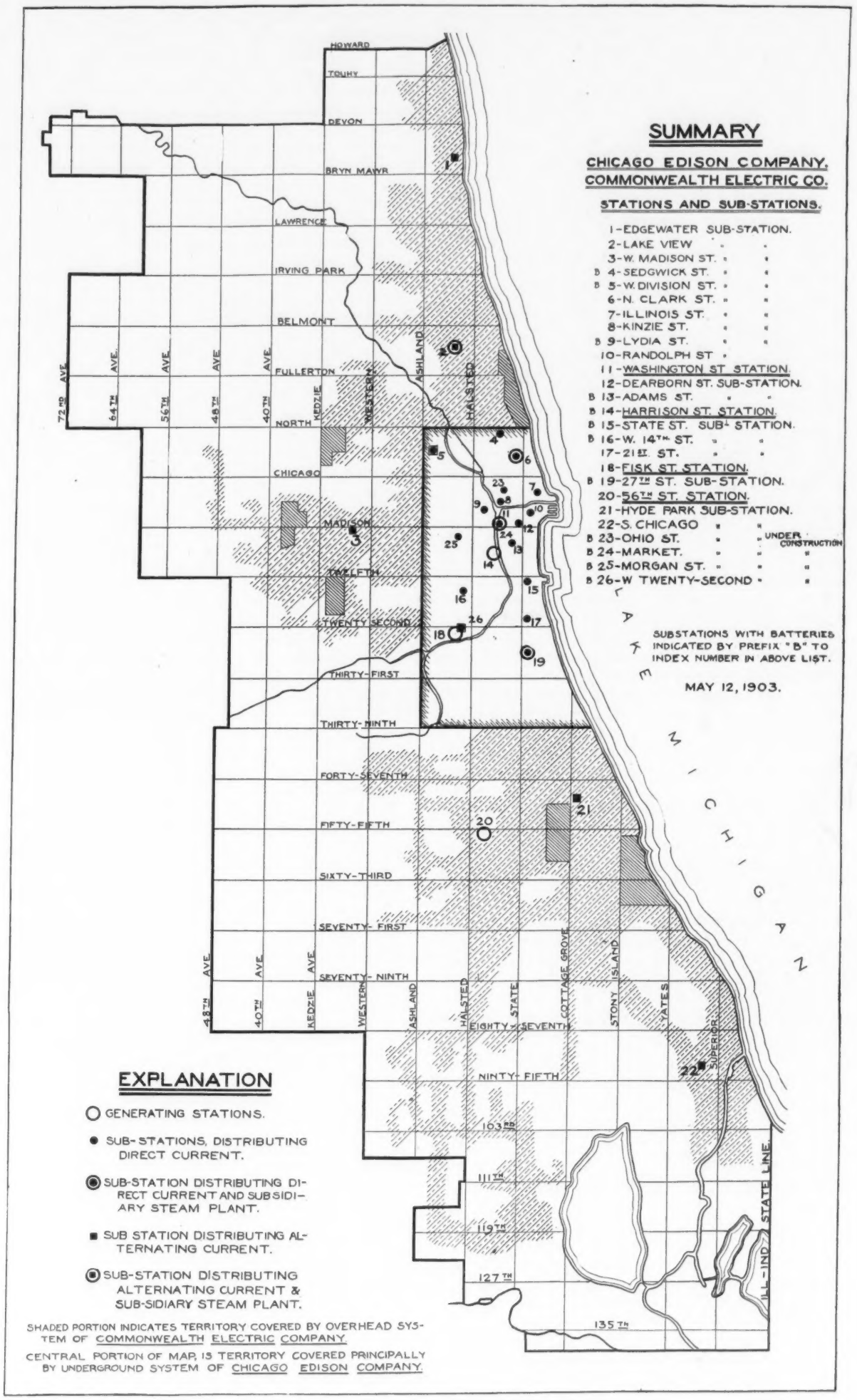


FIG. 10.—MAP SHOWING STATIONS OF CHICAGO EDISON COMPANY AND COMMONWEALTH ELECTRIC COMPANY.

9,000-volt current is put through motor-generators to change its frequency to 60-cycle, 2,300-volt on the 4-wire, 3-phase system. At first glance this would seem like a wasteful operation, but the amount of energy which has to be transformed by motor-generators is so small a proportion of the total as to make it much more economical in carrying the load to have all the large generating units in the new Fisk Street station of the same voltage and frequency, namely, 25 cycles, 9,000 volts.

The Madison Street sub-station is one of those in which 9,000-volt, 25-cycle current is changed in voltage and frequency for alternating-current distribution, and since it is one of those recently finished, it has been selected as an example of this type of station for description here. It gives a good idea of the high standard of sub-station construction which this company requires in all its work, and also has some entirely new features installed here for the first time. The Madison Street sub-station has two 500-hp motor-generator sets, consisting of a synchronous 25-cycle motor driving a 60-cycle generator, both motor and generator of the revolving field type, and on the same base. Exciting current for these motor-generators is supplied by two 50-kw exciters, each driven by a 75-hp induction motor. Fig. 8 is an interior view of this sub-station. One of the new features in this sub-station is the new switching device for the induction regulators. There are six 7½-kw induction regulators of the C. R. type, made by the General Electric Company. Each regulator has mounted upon it, as seen in Fig. 7, a switch for automatically controlling the voltage on the feeder that is supplied through the regulator. Instead of having an individual motor for each regulator switch, a line of shafting has been run the length of the row of regulators. This shafting is driven by a 1-hp motor. There are two magnetic clutches on each automatic switch, one of which when energized will move the regulator switch to raise the voltage, and the other one when energized will move the regulator switch to lower the voltage, by motion transmitted from the constantly-running line shaft. These clutches are energized from a relay contact, and the relay is operated from a shunt around the voltmeter on that feeder. The voltmeter has resistance in its circuit, calculated so that the indication of the voltmeter at any time will show the voltage at the center of distribution of that feeder. As long as the voltage is normal the relay is balanced so that it makes contact with neither of the magnetic clutches. Should the voltage get high or low the relay armature makes contact with one of the clutches, and this moves the regulator switch until the right voltage is attained.

This sub-station is supplied from a 9,000-volt feeder, which comes from the Harrison Street generatinng station. The plan of the 9,000-volt feeders of these companies appeared in the ELECTRICAL WORLD AND ENGINEER of May 9, 1903, illustrating a paper by Mr. Junkersfeld on "Multiple Versus Independent Operation of Central Stations." In addition to the regular feeder supplying this station, another feeder passes through the station and on to what is known as the Rockwell Street sub-station of the Lake Street Elevated Railroad, which is a rotary converter sub-station supplying direct current to that road. The feeder which supplies the Lake Street Elevated can be connected by means of knife switches to the incoming feeder bus-bar in this station. The regular feeder supplying the station can also be connected to this feeder bus-bar by knife switches. These switches are, of course, only for the purpose of making connections, and are never opened under load. The feeder bus-bar supplies the synchronous motors and other apparatus in the station through a main type C solenoid operated oil switch, made by the G. I. Company. All the oil switches in the station are of G. I. make. This main type C oil switch connects the incoming feeder bus, with the motor running bus, from which the motors are operated. There are two sets of motor buses, one known as the running bus, the other as the starting bus.

The starting bus-bar is supplied from the running bus through a compensator, which reduces the voltage from 9,000 to 4,000 volts for starting the synchronous motors as induction motors. The compensator is bus or starting bus energized at the time of starting the motor-generators by connection with the bus-bar through a type H oil switch. The starting of the motor generators is done through a type G switch, which is in reality two 3-pole oil switches with operating mechanism so connected mechanically that one switch will open when the other closes, giving in effect a double-throw oil switch. In starting, the motor-generator is thrown first on the starting bus and then onto the running bus.

In the main circuit of each generator is a type H oil switch for breaking current under load. For passing through this switch the circuit divides, one going through a type E oil switch to the A bus and the other going through a similar switch to the B bus, as there are two bus-bars. These latter switches are not for breaking the circuit under load, but simply for connecting the generator to one bus-bar or the other. Oil switches were, of course, not absolutely necessary for this purpose, but it was not thought desirable to introduce knife blade switches into the generator leads, since by the use of a cheap type of oil switch, all open switching devices could be avoided. The switches in the main generator leads are three single-pole switches. The neutral of the generator being grounded, no switching devices are necessary in it. The lighting feeders are operated as single-phase circuits connected between any one phase and the grounded neutral. It is, therefore, unnecessary to have only one single-pole switch for each feeder circuit. Furthermore, all instrument and potential circuits are run with one wire and the common return, all of which greatly simplifies switchboard wiring. All the 9,000-volt wiring in the station is run enclosed between slate partitions, and where going through one partition into another, insulated bushings are used, made of a new substance resembling hard rubber, known as the Stanton compound. The high-tension switch construction is well illustrated by Fig. 5, which shows the switches at another sub-station where they are more accessible for a photograph than at Madison Street.

Generator panels at this sub-station have for indicating instruments three ammeters, three wattmeters and one voltmeter. In addition to motor-generator panels and feeder panels, there are two panels given to feeders, which tie this sub-station to other sub-stations. These tie feeders also serve branches along the route between sub-stations. Feeders are fused with flat enclosed fuses. A good idea of some of the principal characteristic points of the switchboard wiring and construction of these companies is afforded by Fig. 9, which is the back of this Madison Street sub-station board, and Fig. 6, which is the back of the switchboard at the Sedgewick Street sub-station. It will be noted that the supporting frames are several inches back of the panels, so as not to interfere with the wiring. The direct-current feeders, as they leave the board, have taps taken off about 7 ft. apart for voltmeter leads, so that the feeder cable itself forms a voltmeter shunt. Changes in temperature in the feeder are compensated for by a series winding in the voltmeter circuit, surrounding the cable at the point it leaves the bus-bars. High-tension cables and all exposed places in the station are wrapped with brass tape.

The 9,000-volt cables for underground transmission are all three-conductor with conductors equivalent to 0000. They have paper insulation fixed 6/32 in. thick over each conductor, and the sheathing 4/32 in. thick over all three conductors inside the lead covering. Where the conductors leave the high-tension cables is a large bell filled with a compound called "minerallac," which is the invention of some of the companies' engineers. Manholes for high-tension cables are built so that there are no sharp bends of cables in going around square corners. That is, these manholes are built with diagonal corners. The 9,000-volt transmission lines will by next fall aggregate 60 miles and serve 19 sub-stations.

Four new sub-station buildings are under construction at the present time and the fifth building is being erected to house the present South Chicago sub-station.

The high-tension switching apparatus at Harrison Street station is undergoing a general overhauling, whereby feeder and generator oil switches, which are all solenoid operated, will be placed in separate fire-proof compartments, so isolated as to prevent the spread of trouble. The feeder switches will be equipped with overload and time limit devices, whereby they will open upon overload, but not until the overload devices at the far end of the feeders may have had time to act. Feeders are taken from a transfer bus, which is sectioned, and each section of this bus is fed by a generator. Each generator has three oil switches, all without overload devices. One of these switches controls the entire output of the generator. After leaving this switch, the circuit divides, one going through an oil switch to the transfer bus, from which the feeders are taken, and the other going through an oil switch, connecting it with the main bus.

Another notable change being made is one which will eventually result in the substitution of a sub-station having very large units, in place of the power house at Market and Washington Streets, which power house it is expected to shut down, except possibly for heavy load work, as soon as the Fisk Street station is in regular

operation. This Washington Street station now occupies part of a large manufacturing block, known as the Electric Block. A new eight-story modern steel building is to be erected in place of this, in which the sub-station will occupy part of the main floor. This sub-station will have room for eight 1,000-kw rotary-converters, but the company's engineers have had the foresight so to lay out the floor space that one 2,000-kw rotary converter could be installed in the same place as three 1,000-kw machines. This station will be served by a traveling crane. The air blast chamber in the basement of this sub-station will be utilized for high-tension bus compartments. One notable feature here, will be the use of transformer regulators, which will give a large enough range of voltage so that no boosters will be necessary to raise the direct-current voltage, for charging storage batteries at this sub-station. There are many other interesting new sub-stations, as has been mentioned, but it would be impossible in the space available for this article to go into the details of all of them. With what has been published before in these columns, the foregoing will give a good idea of the recent developments in the systems of these two companies.

The New Plant of the Oskaloosa Traction and Light Company.

Oskaloosa, Iowa, has for many years been the home of one of the oldest and in some ways the most remarkable direct-current incandescent lighting plants to be found in the central states. Before electric lighting was thought of a company called the Oskaloosa Power & Land Company built a steam power house and some factory buildings on a large tract of vacant land something over a mile from the business center of the city. This land was well served by railroads, and it was the idea of the promoters of this company that if power, buildings and land were furnished manufacturers would flock in to avail themselves of the privileges offered. The manufacturers refused to flock, however, and matters looked blue for the power and land company.

FIG. 1.—CHANGING FROM OLD TO NEW POLE LINE.

About that time incandescent lighting from central stations began to be talked of, and the outcome of the matter was that an Edison three-wire, 110-volt, direct-current system was installed in Oskaloosa, and the generators were located in this power house. The amount of copper required to give lighting service on a low-tension, direct-current system with the station so far from the center of distribution is easily imagined by those familiar with the subject. Nevertheless, the copper was put up, and the plant gave good service for many years in spite of the investment which it had on its pole lines. In all about 57 tons of bare copper wire were put up—a figure seldom equaled in a town of this size. Oskaloosa had a population of 9,212 in 1900.

Last year parties interested in the Ottumwa Traction & Light Company, operating in a neighboring Iowa city, obtained control of the lighting plant in Oskaloosa, and secured franchises for several miles of street railway. It was decided to abandon the direct-current system entirely, and put everything on a three-phase alternating-current system. This meant a very radical change, not only in the distribution system, but in the power house and motor service; for the old company had 45 direct-current motors owned by its customers to whom it was supplying current. The change, therefore, involved the practical rebuilding of the whole plant. The solution of the problem was heroic, but it has resulted in thoroughly up-to-date equipment. The old power station is being abandoned, and a new one, somewhat nearer the business part of the city has been started. Incidentally, about 35 tons of bare copper feed wire are being taken down, this feed wire constituting one of the chief marketable assets of the old property. The service is being transferred from the old to new pole lines in the business district, which change is in progress in Fig. 2. The pole line from the new station is seen in Fig. 2, which shows the substantial character of the work.

FIG. 2.—FIVE-ARM LINE LEAVING NEW STATION.

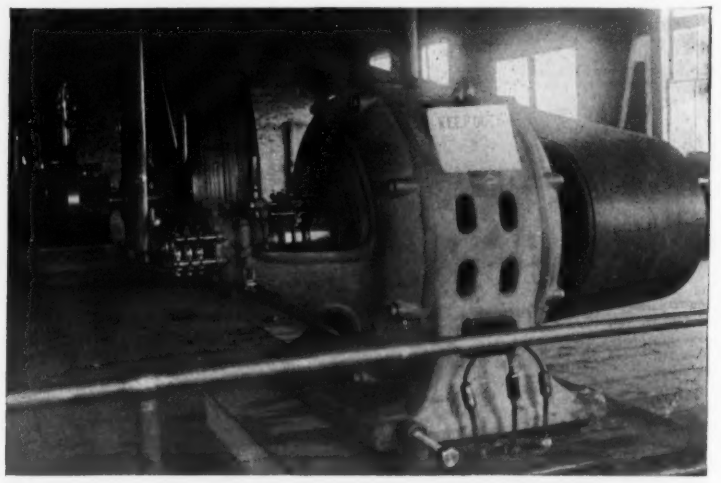


FIG. 3.—ONE OF THE GENERATORS.

The new plant is six blocks from the business square, which is sufficiently near so that some hot water heating can be done. The Yaryan system has been installed. The company has 3,300 ft. of

mains. The new plant gives power and lighting service at 2,300 volts, 3-phase, 60 cycles. Single-phase lighting circuits are taken from the three phases of the power house bus-bars, independently of the 3-phase power feeders. Whatever fluctuation there is in the voltage of the lighting service from the starting and stopping of motors will, therefore, be confined to the fluctuation of voltage on the generator, as the feeders and transformers are independent of each other. In changing from direct-current to 3-phase motors, the company has accepted the customers' direct-current motors in trade, although many of these motors are of little market value.

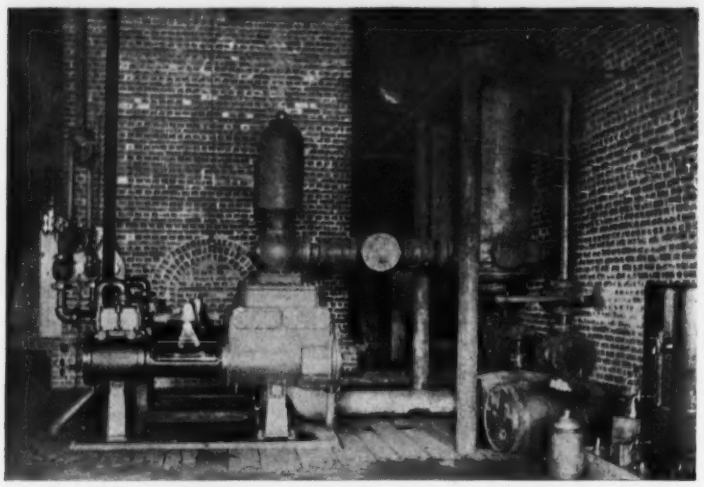


FIG. 4.—HOT WATER CIRCULATING PUMPS.

Formerly all the street lighting in Oskaloosa was done by incandescent lamps. A new contract has been made with the city, and the Oskaloosa Traction & Light Company is now supplying 101 enclosed General Electric street arc lamps, operated in series off of tub transformers. There are three tub transformers giving 2,200 volts, 6.6 amp. Two of these transformers supply street lights and other lights operated until midnight, and the other supplies all-night arc lights.

The power house equipment comprises two 200-kw, three-phase General Electric alternators of the compensating field type, with the exciter built into the machine. These machines run 600 r.p.m., and give 2,300 volts. One of these generators (Fig. 3) is belted to a Reynolds Corliss engine, built by the Allis-Chalmers Company. This engine is rated at 305 hp, and runs 96 r.p.m. The other three-phase

FIG. 5.—COAL AND ASH HANDLING.

generator is belted to a Westinghouse high-speed engine, rated at 330 hp. This engine is 18 and 30 in. x 16-in. stroke, running 250 r.p.m. This engine also drives a railway generator which at present is an old D 62 machine. This will be changed, however, for a new generator. The engine room contains, besides these two units, two Gardner pumps for maintaining the circulation of hot water in the heating system. These pumps are 14 and 12 in. x 12-in. stroke. There are three Stirling water tube boilers of 258 normal hp each. The brick stack 125 ft. high was built by the Alphons Custodis Chimney Construction Company, according to that company's well-known form of chimney construction, using hollow radial molded brick. A "Star" vacuum class C feed water heater with a capacity of 30,000 lbs. of water per hour is located in the boiler room, where also are Gardner feed pumps. A siding of the Burlington railroad runs pas the boiler room at an elevation, as seen in Fig. 5, so that

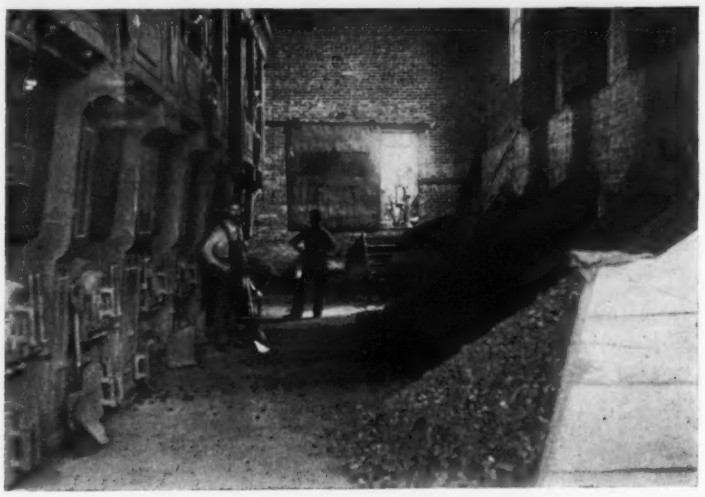


FIG. 6.—NO SECOND HANDLING OF COAL.

coal cars can be dumped into pockets, which pockets discharge directly in front of the boilers. If dump coal cars are not obtainable, the coal is shoveled directly in front of the boilers, Fig. 6. The ashes are taken out in wheelbarrows on to a platform and dumped into street railway cars for use in ballasting. Besides the light and power service three cars on four miles of street railway are operated, which is considered to be a remarkably good service for a town of this size.

The rates for lighting are 15 cents per kw-hour, with discounts which give a rate as low as 5 cents per kw-hour to some of the largest users. The rates for power are 10 cents per kw-hour, with discounts as high as 50 per cent. to the largest users. For hot water heating, a rate of 17½ cents per square foot of radiating surface for the season has been established.

The officers of the Oskaloosa Traction & Light Company are: President, H. E. O'Neal; vice-president, Samuel Mahon; secretary, general manager and purchasing agent, J. F. Springfield; treasurer, Calvin Manning; auditor, H. W. Garner. The local management is under the supervision of Mr. Garner. The plant was laid out by and is under the general management of J. F. Springfield, of Ottumwa.

Interesting Southern Lighting Plant.

Gaffney, S. C., has its own lighting and pumping plant. The air lift is used, connected to a well 12 in. in diameter and 565 ft. deep and delivering to a cement motor-lined brick reservoir, through the center of which rises the well. The well and reservoir lie just outside the station, and the reservoir is about 20 ft. in inside diameter and 12 ft. deep. The air compressor is of the Laidlaw-Dunn-Gordon horizontal fly-wheel type, 14 in. x 14 in. x 18 in. in cylinder sizes and to start the water, compresses to 120 pounds. The normal operating air pressure is 80 pounds. From the reservoir the water is pumped to a 120-ft. standpipe, 15 ft. in diameter, by means of a Worthington 14 in. x 8½ in. x 10 in. duplex direct-acting steam pump. The plant is operated about 10 hours every night. A constant-current alternating system of arc lighting is in use, with a duplicate installation of machinery. There are two General Electric 60-cycle alternators, rated at 39 amp., and 2,300 volts at 900 r.p.m., each belted to a simple engine built by the Slater Engine Company, of Warren, Mass. Each generator has a 125-volt exciter driven by belt from the generator shaft, of 1.5-kw capacity. The lighting transformer is of 32-kw capacity and gives a current of 6.6 amp. The building is of brick with a concrete floor and mortar plastered walls inside.

Development of Light and Power Business at Red Oak, Iowa.

IN looking over the field of small central stations for description in this number of ELECTRICAL WORLD AND ENGINEER, that of the Red Oak Electric Company was selected as being one which has developed an unusually large amount of electric light and power business for a station located in so small a town. The plant is under the management of D. F. McGee, the recently elected president of the Iowa Electrical Association, who is also known over the country for the part he has taken in the proceedings of the National Electric Light conventions. Mr. McGee has demonstrated that the complaint so often heard from the managers of central stations in towns of the size of Red Oak, that there is nothing in the power business in such towns, and that "this town is too small for a paying electric light and power enterprise anyway," are usually groundless, and simply the result of inability or unwillingness to expend the effort and money necessary to get and take care of the business.

The population of Red Oak, according to the census of 1900 was 4,355. Up to three years ago, at which time Mr. McGee took charge, the company had no power business. A few weeks ago, when the representative of this journal visited this plant, there were connected for power service fifty-seven 220-volt motors of over ¼ hp, and eight 500-volt motors, ranging from 85 to 5 hp. This does not include the various fan and dental motors under ¼ hp. On the 500-volt circuit there is one 85-hp motor operating a flour mill 24 hours a day, one 45-hp motor running the water works pump about 8 hours a day, one 10-hp motor, two 7½-hp and three 5-hp motors. Of course, it would be impossible for every town of this size to develop such a large power business, because not every town has a sufficient number of enterprises using power. Nevertheless, the fact remains that in Red Oak, electric motors have displaced nearly every steam plant in the town, and in some notable cases, to be mentioned later, have supplanted steam engines where, to a casual observer, it would seem to be impossible to get the prospective customer to give up the steam plant. When the power business was started in Red Oak three years ago, it was run from a 220-volt direct-current circuit, and the business was mainly confined to the operation of motors in the stores and printing offices located around the business part of the town, which is but a short distance from the central station. Later, as it was found feasible to take on some larger power users, the 500-volt service was inaugurated. In fact, this service was first started to operate the 85-hp motor driving the flour mill, some distance from the station. This flour mill furnishes an excellent load, as it operates practically 24 hours every day, and forms a good basis upon which to build up further 500-volt service. Of course, the division of the power service into two classes, 500-volt and 220-volt, is in some respects not ideal; but like every lighting station, that at Red Oak has been a gradual evolution, and machinery has been installed from time to time as seemed best to fulfill the requirements. The use of a 220-volt, two-wire power service for the busiest part of the town makes it possible to give incandescent lighting service on the same circuits in the daytime, and to shut down the alternating-current residence lighting dynamos during the day.

The station (Figs. 1 and 2) though old, has been kept in good shape, and while not finished according to modern ideas of electrical engineering in large plants, is enough more efficient than any of the steam plants likely to be operated by small manufacturers in a town the size of Red Oak, so that the central station can successfully compete for power business. This power service is principally taken care of by a 225-hp 16 x 42-in. Filer & Stowell Corliss engine, which drives a line shaft, to which is belted one 60-kw, 220-volt Holtzer-Cabot generator, and one 110-kw, 500-volt General Electric generator. From this line shaft there is also driven a centrifugal pump (Fig. 3), which circulates the hot water in the hot-water Yaryan heating system operated from this plant. Another section of the line shaft is driven ordinarily by an 18 x 36-in. Sioux City Corliss engine. From this line shaft there is belted one 25-kw, 220-volt, direct-current generator, and two 35-kw, 1,100-volt alternating-current, 125-cycle dynamos. The line shaft is arranged so that the larger engine can drive the entire shaft when the load is light. This is done by getting together the two sections of the shaft by means of a friction clutch, and lifting the engine belt off the surface of the line shaft pulley by means of pieces of gas pipe placed under it, and resting on a frame (seen at the left in Fig. 2), which frame is built in the form of a semi-circle slightly larger in diameter than the pulley, from which the belt is to be lifted. The belt is kept tight by means of an idler, so that it is easily loosened enough that it can be lifted off the pulley to allow the pulley to revolve free. During the day, only the section of line shaft first mentioned as connected to the Filer & Stowell engine is driven. The maximum load on the 500-volt power circuit during the day is about 180 amp., and the minimum about 125 amp. The load on the 220-volt circuit during the day runs about 100 amp. In the winter, between 5 and 6 o'clock, when the downtown lighting is included

FIG. 1.—RED OAK CENTRAL STATION.

also in this load, it runs as high as 300 amp. The maximum alternating-current peak load is 70 amp. at 1,100 volts. These figures will give some idea of the amount of business the station is carrying.

All the 500-volt motors are supplied through recording meters, and it is found that there is only 15 per cent. difference between the reading of the main recording wattmeter on the 500-volt circuit at the station and the totals of the consumers' meter readings. This is much less than the difference usually found on direct-current light and power circuits, and this is probably due to the fact that because the 500-volt meters are comparatively few in number and of large capacity, and run usually at a fairly good load, there is but little loss through motors running too slowly. It should be mentioned in this connection, however, that the 45-hp motor driving the waterworks pump has its wattmeter located in the central station rather than at the waterworks, which are a mile or more distant; hence the line loss on this circuit is not included in the wattmeter readings before mentioned.

Besides the electric service which has been enumerated, hot water heating service is applied to the business part of the town. The company has connected now about 50,000 sq. ft. of radiating surface. The pipes around the business quarter are run through the front of the cellars, which not only keeps down the cost of making service connections, but does away with digging trenches in the streets. It is found that building owners gladly permit this to be done even if they do not take the hot water service, because it puts them in a position where they can take it at any time, and increases the rental value of their property. A static head keeps a water pressure of 30 pounds to the square inch on the heating system. To force the circulation of water, a centrifugal pump adds 22 pounds to this static head, so the outgoing pressure is 52 pounds, and the incoming equal to the static head, or 30 pounds. The temperature of the outgoing water in the coldest weather is 165°, and that of the incoming water 155°. The mains are incased in Wycoff sectional covering. As said before, the centrifugal pump is driven by a belt from the line shaft. There is also in reserve a centrifugal pump driven by a small Westinghouse Junior high-speed engine, which was one of the first installed for lighting service in the station years ago.

By ordinarily driving the circulating pump for the hot water system from the line shaft, the benefit of the economy of the Corliss engine is obtained. From indicator cards taken on the Corliss engine, it is found that it requires 20 hp to run the centrifugal pump. The actual cost of operating the hot water system is, therefore, the cost of supplying this 20 hp continuously, except in the coldest weather, when a little live steam is used. Mr. McGee does not believe in connecting up more radiating surface than can be operated with the engine exhaust in ordinary cold winter weather, as live steam heating is too expensive.

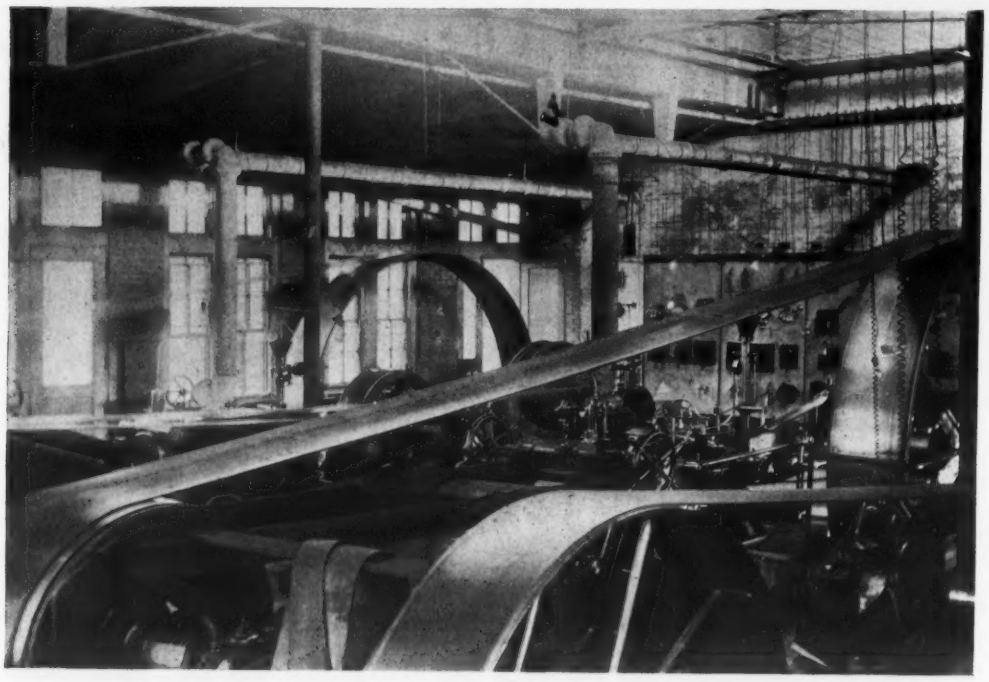


FIG. 2.—INTERIOR RED OAK STATION.

The boiler plant contains two boilers 60 in. in diameter by 16 ft. long, and two 74 in. in diameter by 16 ft. long, all of the usual horizontal return flue type. Three boilers are usually run to carry the load, but do not require very hard firing under such circumstances. For carrying peak load, a forced draft is available.

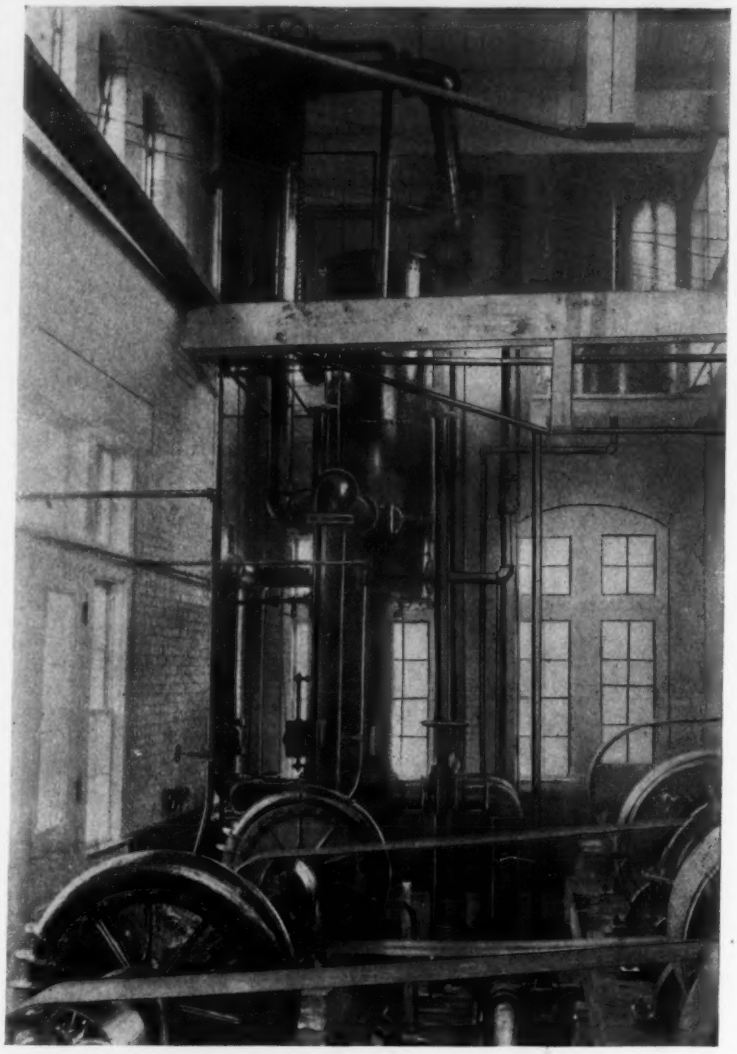


FIG. 3.—CENTRIFUGAL PUMP AND HOT WATER HEATERS.

In operating the stations, two day and two night men constitute the force. The outside force consists of two men and one boy; and these men do all the work on new wiring contracts, of which there is considerable at the present time.

This station was one of the first in Iowa to do waterworks pumping by electric motor from the central station. The waterworks is located about a mile from the station, and takes its supply of water from an open well near a river. It was formerly operated by steam, by direct-driven steam pumps. When the electric company secured the contract the company put in a 45-hp, direct-current motor, belted to a triplex pump, letting the steam plant stand ready for use as before. This pump operates against a head of 100 pounds to the square inch. The capacity of the standpipe is 238,000 gallons. The company is pumping about 112,000 gallons a day, so that there is plenty of capacity in the standpipe to enable the company to pump at times best suited to the economy of its plant. The rate paid by the city for pumping is $125 a month, the company to pump for this amount 100,000 gallons of water per day. For all water in excess

of 100,000 gallons pumped each day, a rate of 4 cents is paid. The cost of the pumping apparatus put in by the company is given as $2,500. Mr. McGee figures that the company is receiving 4 cents per kw-hour for current used in city pumping, after deducting interest at 6 per cent. and depreciation at 6 per cent. on a $2,500 investment in pumping apparatus. It will be seen that as long as more than 100,000 gallons of water is pumped per day, the rate is practically 4 cents per 1,000 gallons. If 112,000 gallons are pumped per day, the interest and depreciation would be $0.007 per thousand gallons, making the rate received for pumping, after deducting interest and depreciation, $0.033 per thousand gallons. If the company is receiving 4 cents per kw-hour for current used in pumping, and $0.03 per thousand gallons, the energy consumed would be .82 kw-hours per thousand gallons. Mr. McGee does not consider the pumping rate a profitable one, except for the city which is saving from $1,800 to $2,000 per year on the contract over what it would have to pay to maintain a steam plant. The city could well afford to pay a higher rate.

The power rates are 7½ cents per kw-hour, with a discount which allows some of the very largest users 30 per cent. off. Most of the output, however, is paid for at the 7½-cent rate. The lighting rates for stores on the 220-volt circuit is 15 cents per kw-hour. The residents' lighting rate on the alternating-current circuits is 20 cents per kw-hour, with no discount and no minimum rates. Allowing 6 per cent. for interest and 6 per cent. for depreciation, it is figured that power costs at the switchboard of this plant 5 cents per kw-hour. This does not include any depreciation charges. The hot water

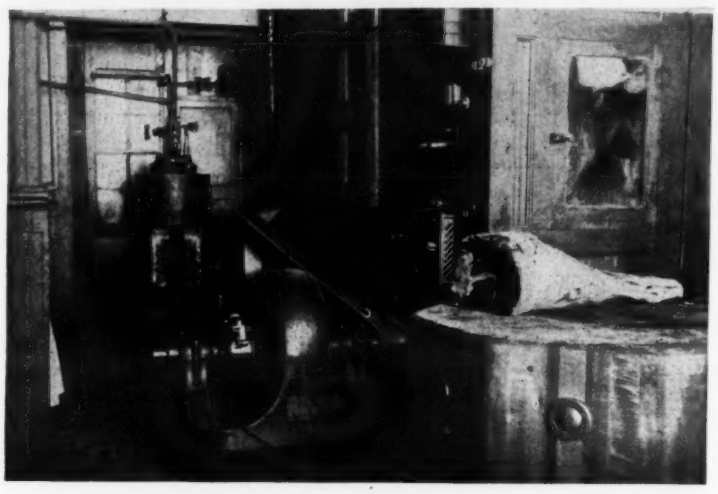


FIG. 4.—A PROGRESSIVE MEAT MARKET REFRIGERATION PLANT.

feeding rate has heretofore been 15 cents per square foot of radiating surface for the season. This is to be increased to 20 cents the coming season. Coal costs normally $1.90 per ton.

It is interesting to note the character of the motor load. Motors connected to this station are employed on 35 different kinds of work; and out of the 65 motors, only 15 are not arranged to be operated on variable speed. The necessity for variable-speed motors was largely instrumental in the selection of direct current for power service when this service was begun three years ago, rather than single-phase alternating-current motors.

It is especially notable that two laundries which have to maintain small boilers for use in the laundry have abandoned steam engines in favor of electric motors, and find it greatly to their advantage, because with no engine to run boiler depreciation and expense is so much less and the electric motor requires so little attention, being always ready for service whether steam is up or not.

The largest motor, as said before, is the 85-hp motor of the flour mill. This mill had an efficient Corliss engine and good boiler plant, but it was found, everything considered, that the electric power is more satisfactory in the long run, and probably no more expensive. It is unusual to find an ice machine in operation in so small a town as Red Oak, but one of the meat markets has installed an ice machine, driven by an electric motor (Fig. 4), and maintains a large storage room for its meats, and is thus enabled to serve its customers much better than customers are usually served from meat markets in small towns. This motor is installed under a contract that it shall be turned off during the period of heaviest load if the company so directs. As it is only necessary to operate the ice machine a part of the time, this helps give the station an all-day load, and one which does not increase its requirements at the time of the peak. Several motors are in use driving ice cream freezers, coffee mills and sewing machines. A large calendar company in Red Oak, the Thomas Murphy Company, has a thoroughly modern plant, equipped with individual motors for each machine. There are 22 motors in this plant. While the cost of individual motors is, of course, considerably more than that of single motors with line shafting, the fact that there are no shafts and belting to interfere with the work and throw dirt and oil makes the individual motor scheme much preferred by the management of this establishment. The other printing establishments of Red Oak also have electric motors.

The waterworks pump is started and stopped by simply throwing a double-pole switch at the central station. An automatic starter, made by the Elektron Manufacturing Company, is placed at the waterworks for starting the pump when the current is turned on. In order to keep the pump primed, a small jet of water discharges onto one of the plungers when the motor and pump are in operation.

The capital stock of this company is $30,000; but the present investment is in the neighborhood of $80,000, although no additional stock has ever been issued.

The foregoing are the principal points regarding one of the progressive central station companies of Iowa; and they give encouragement to further effort on the part of other companies similarly situated. The company has never gone through any revolutionizing changes in its station, involving heavy investment, and has worked along little by little, enlarging as necessity demanded it. While this policy may not have resulted in as thoroughly uniform and modern a plant as some engineers would wish, it is, nevertheless, as can be seen from the foregoing, a plant which is paying, and from the fact that it is getting so much business, must be giving reliable service. The experience of this company simply goes to demonstrate what can be done by good management with a station and equipment of the kind that prevails in the majority of small towns, and without any very revolutionary changes.

The Loss on British Telegraphs.

A special cable dispatch from London of May 16 says: A statement of the income and expenditures of the telegraph system since the Post Office Department took it over in 1870, shows that for the first two years the revenue paid the interest on the purchase money. In no single year since has it been sufficient to cover the interest charge. The deficiency in the year 1872 was £119,000. This has steadily increased, until last year it was £950,740.

The major portion of the deficiency was due to the heavy charge for salaries, which is yearly growing more rapidly than the increase in the revenue. A few years ago a committee was appointed to investigate the condition of the post office employees. They made liberal recommendations in regard to an increase in wages. These were carried out at an immediate cost of £500,000 annually.

Fresh demands are now being put forward and will be a matter of debate in the House of Commons. Mr. Austen Chamberlain, the Postmaster-General, wants to submit the demands to a committee of business men. The employees object, as they are anxious to have the matter go before the Committee of the House of Commons. They know that they can by their votes bring pressure to bear on members of Parliament in their favor. This is one of the very grounds on which John Burns, the Socialist leader in the House of Commons, recently advocated the disfranchisement of all government employees.

National Fire Protection Association.

The seventh annual meeting of the National Fire Protection Association will be held at Chicago, at the Chicago Underwriters' Association, 159 La Salle Street, beginning Monday, May 25, and lasting four days. A very full and interesting programme will come up for consideration and among special reports to be presented are those on thermoelectric fire alarms, F. E. Cabot, chairman; heavy current protectors on wires of signalling systems, R. Sweetland, chairman, and electric fire pumps, Mr. Sweetland. Exhibits of various kinds will be made specially at the Underwriters' Laboratories, 67 East Twenty-first Street, on Thursday, May 28, which will prove of great interest to the members. The president is Mr. C. A. Hexamer, and the secretary and treasurer is Mr. E. U. Crosby.

The Pontiac Light and Water Co., Pontiac, Ill.

THE much-discussed question of securing a profitable day load has been successfully solved by the Pontiac (Ill.) Light & Power Company. Not only has this been accomplished, but very gratifying results have been obtained in other directions. Although possibly the engineering features of the plant are not as up-to-date in every particular as in some of the larger and more modern central station power houses, nevertheless, all improvements warranted by a sound business policy have been made, and others will be added from time to time, as the finances of the company permit. As power is to be furnished by the company to a proposed interurban line to run through Pontiac, it has been decided to delay temporarily several improvements contemplated until such time as definite plans have been decided upon for the latter.

Pontiac is a small town of about 6,500 inhabitants, situated on the main line of the Chicago & Alton Railroad, 92 miles from Chicago. Branch lines from two other railroads also enter the town. At the present time it is not reached by any interurban electric road, although, as already mentioned, such a one is being planned. The manufacturing as well as the business interests are such as are usually to be found in towns of such size, and as a consequence do not offer any special advantages for an electric light business or other public utilities.

Due to a desire to unite all of the public utilities except the telephone business under one management, as well as to prevent possible ruinous competition, the Pontiac Light & Water Company owns the electric light plant, the water works, an exhaust steam heating system, is installing a gas plant, and will furnish power to the proposed interurban railway. Although, of course, it is a popular conception that competition is the life of business, nevertheless the management appreciates the fact that, especially in a town of such a size, competition is ruinous, and, furthermore, the cost of management alone would be prohibitive, or at least burdensome in the case of several concerns. The modern tendency to unite under one management as many correlated interests as possible, certainly results in decreased operating and managerial expenses, and must benefit the public at large because of decreased cost of production. For an electric plant having a day load it is not only natural but also profitable to engage in the heating business. It is but a step further, especially when conditions are favorable, as they were at Pontiac, to engage in the water business. To prevent what might be ruinous competition, to exploit a field which not only serves to do pioneer work for the electric business, but also covers a field of its own which cannot in any way compete with the former, a gas plant has been installed.

The secret of the success of the electric light plant is due in no small measure to the securing of a large day load. As this is a matter of vital interest to all central station men, it may prove of interest to note the manner in which this was obtained. As Mr. Fred L. Lucas, the manager and secretary, very aptly expressed it, to secure such a load it is necessary first of all to operate day circuits and then to secure the business. The merchant, to do business, must have articles which he wishes to sell, upon his shelves. Samples will not suffice. A brief review of the methods so successfully pursued will no doubt be of value. That the mere operation of a day circuit alone will not suffice is self-evident. A progressive, energetic, pushing personal campaign is required to acquaint the public at large and the prospective user in particular, with the advantages to be secured in using the electric current. This campaign has been augmented by judicious and systematic advertising in the local papers, calling attention to the advantages of each particular piece of apparatus to be pushed, and more particularly to the disadvantages of competing articles. As will be noted from the accompanying advertisement, attention was called to and particular stress laid on the danger of using gasoline arcs, and incidentally the safety, cleanliness and good light to be obtained by using the electric current.

The following advertisement is here reproduced to afford those interested in small central stations an opportunity to study the methods pursued.

Another factor for securing business, especially power, is to have a few motors in stock which can be used for supplying an immediate demand. Mr. Lucas related an incident which brought out this point very clearly. He had been trying for over two years to place a motor in a printing establishment, but without avail. At last came the opportunity. The gasoline engine broke down—it could not be repaired in time—could Mr. Lucas help them out? A one-hp motor temporarily did the work of one three times the size. The evening edition was but one hour late, and an entry had been secured where formerly the gates had been closed. Now two motors are required to take care of the work in this establishment. Another factor in the securing of the business has been the policy

Gasoline Not Sold for Illuminating Purposes in Houses.

Have you noticed this heading on the bills and other forms of the Standard Oil Company?

Do you catch the significance of it?

They manufacture practically all the gasoline made and yet won't sell it to illuminate your house. Take this hint before you have cause to regret not doing so.

For a good light, one that is reasonable in cost and perfectly safe, use electricity.

FIG. 1.—PONTIAC LIGHT AND POWER COMPANY.

of making it easy for customers to secure their motors, or whatever other apparatus has been required. The customer pays the same price at which the company secures the apparatus, with enough added to pay freight and cost of installing. An original payment of 10 per cent. of the total amount is required, and the balance is distributed over several months in easy payments. These are but a few of the more important points in the aggressive campaign made by the Pontiac Light & Power Company, and these, of course, can be augmented and varied to suit local conditions.

A very instructive and interesting study of the operating conditions of the plant can be made. In general it can be said that the demands made by the different loads on the power house go hand in hand. The heating system makes its greatest demands on the power house when the electric light load is greatest; and in summer when

Perfect Work

can only be accomplished in a light, clean, well ventilated shop.

With an Electric Motor there is no

Smoke, Dirt and Oil

to cause trouble and annoyance. You can use them anywhere, on any floor, on the wall, or on the ceiling.

We sell the General Electric Co's., Motors cheaper than you can buy them elsewhere, and we fully guarantee them. Easy Terms.

Pontiac Electric Company.

FIG. 2.—PONTIAC LIGHT AND POWER COMPANY.

no heating is required all exhaust steam is utilized by an ice plant, which is run in conjunction with the power house, but is owned by other parties. In the plant of the Pontiac Light & Power Company electric current may be considered a by-product. As is well known, the greatest economies result from the complete utilization of raw materials and all by-products, and from a financial standpoint this certainly appeals most strongly to the stockholder. As already stated, the heating plant in general makes its greatest demand on the station when the load is heaviest, although in times

of very severe weather live steam has to be used in conjunction with the exhaust. Arrangements will be made to determine the exact cost of operating the heating system next winter, although to judge from the data available so far, the management has come to the conclusion that it has paid handsome returns on the investment. Another point which is a valuable feature, and concerning which nothing is to be found in text books, is the arrangement between the company and the ice people whereby the ice plant load is thrown off the power house at the time of the peak. As the brine is of such a volume as to afford sufficient storage capacity of cold, no bad results follow. It may be of interest to note that the power house furnishes not only the power required for the ice business, but also the distilled water employed in the system used, the steam for reboiling the condensed exhaust steam from the power house and the water for the ammonia condensers.

The commercial load consists of 100 arcs, the equivalent of about 6,000 16-cp incandescent lamps, and thirty-six 500-volt motors of ¼ hp and larger of an aggregate capacity of 170 hp, besides a large number of small dental and other motors, and 120 fan motors. There is also one three-phase, 60-cycle, 220-volt motor which drives an ice machine.

Because of low rates which were in force at the time the plant was bought, it has not been possible to differentiate between different classes of customers, a flat meter rate of 10 cents per kw-hour being charged, and in the case of customers not owning a meter, a minimum rental of 25 cents per month. This, combined with a minimum charge of 75 cents, makes an actual total minimum charge of $1.00 a month. Customers pay for all installations and renewals of lamps. A cash discount for prompt payment has not been inaugurated, as it was felt that such a course under the existing conditions, would mean a loss, although this system has been adopted with good results in the case of steam heating customers. A charge of 6⅔ cents per kw-hour is made for power, and in case a guaranteed minimum of $15.00 a month is made, the price of the current is reduced to 5 cents per kw-hour. All bills are payable between the 1st and the 10th of the month.

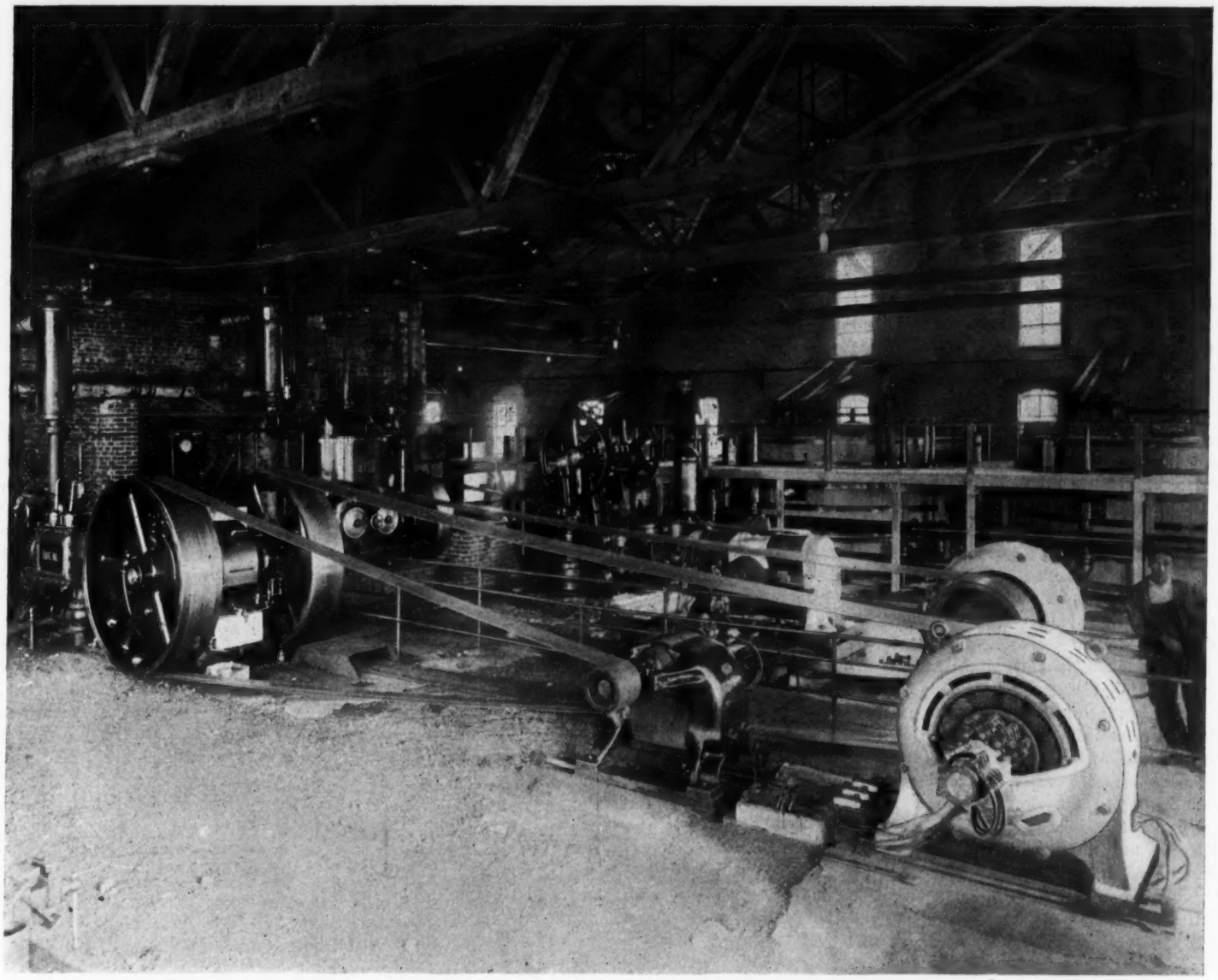


FIG. 3.—INTERIOR VIEW OF THE PONTIAC LIGHT AND POWER COMPANY'S STATION.

The earlier company passed through many vicissitudes, and changed hands frequently, until it was bought by the present owners November 1, 1899, and incorporated as the Pontiac Light & Water Company. Mr. J. A. Carothers is the president and treasurer, and also principal owner, and Mr. Fred. L. Lucas the manager and secretary. Although the capital stock of the company is $140,000 and 5 per cent., 25-year bonds to the amount of $125,000 are outstanding, the assets ($320,000) greatly exceed the liability, and the business, due to the conservative and at the same time progressive management, is in excellent condition.

The company has the contract for the city lighting, which includes forty-six 6.6-amp. constant-current General Electric alternating enclosed arc lamps and 60 3.5-amp. series incandescent lamps for the lighting of alleys and the outlying districts, for which the city pays at the rate of $72 for the former and $15 for the latter, per year.

The accounting system under Mr. W. H. Hessin has been developed to a proficient state, such as is warranted by the amount of business transacted. The card system is used wherever practicable, and a modified system of ledger accounts with individual customers is used. Because of peculiar local conditions, all bills are made out in duplicate, the latter serving merely as a memorandum for the customer, who receives the original receipted when payment is made at the office. A color scheme has been adopted whereby all bills or other records relating to any department can be readily

separated from others. The number of customers served, some of whom, as for instance the County Farm, are located outside of the city limits, is about 525.

The power house is located on the Vermilion River, near the business center of the town. It is a brick structure, 98 x 110 ft., and was rebuilt when the present company secured control. The equipment at present includes two 259-hp Stirling boilers, provided with ordinary grates, and connected by a sheet iron breeching with a brick stack 125 ft. in height, 6 ft. in diameter, and having an inner core 70 ft. in height. The present layout is such that another boiler can be added without any difficulty. The coal has to be hauled to the boiler room, and as soon as the interurban road is completed will be obtained from the railroads by a spur run from the former. It is proposed to install a coal conveyer and coal bins reaching to the boiler room floors, with sloping cement floors, so that the coal will feed automatically and be convenient for the firemen. A small boiler pump is also located in the boiler room, and serves to pump the water for the boilers directly from the river in case of an emergency. Under ordinary conditions, the boiler feed is taken from the city supply, which has been purified in a Jewell filtering system and is heated in summer to about 130 or 140° by a 500-hp Cochrane feed water heater. In winter, as already mentioned, on account of the demands of the heating system on the exhaust, the temperature of the feed is not as great. The heater is so arranged that exhaust steam can be passed through it or be passed entirely.

Steam is generated at 145 pounds and supplied to the engines through a 10-in. main. A 16-in. and 22-in. by 16-in. tandem compound Ideal engine is belted to one 150-kw, 2,300-volt, 60-cycle General Electric compensated revolving-field alternator, and one 45-kw, 500-volt Wood generator. A 14 and 24 x 14 Westinghouse compound engine is belted to one 150-kw generator, identical with the one already described, and one 60-kw, 500-volt United States generator. A 12 x 12 single-acting triplex Gould pump of ? capacity of 750 gallons per minute is driven by a Renold's chain directly from the shaft of the Westinghouse engine. A 500-volt variable-speed motor, however, will be used to drive this pump later on. Two steam pumps which are located in the old water works plant are to be transferred to the power house and used in cases of emergency, or when the Gould pump is overhauled. As will be inferred from the generators mentioned, a 500-volt power circuit is maintained. As street railway generators are shortly to be installed and because of the great expense that would be incurred in changing to any other system, it has not been considered advisable to discontinue this circuit. The 30-hp motor driving the ice machinery, however, is a three-phase alternating one.

A standard 2,300-volt alternating system is maintained for the commercial lighting. This is supplied by the two compensated revolving field generators. Two 25-lamp, 6.6-amp. General Electric constant-current transformers are installed for the city lighting. The switchboard which was also supplied by the General Electric Company contains one panel having instruments for measuring the total output of the alternating system, another does the same for the 500-volt power circuit, one contains the instruments for the series incandescent circuit, another is devoted to the series transformers, two to the generators, and one is a distributing panel. The switchboard is of standard construction, but it is interesting to note that as the alternators are three-phase and the circuits single-phase, it is necessary at times to change circuits over from one phase to another in order to balance the load on the phases. This is especially true on Sundays when the store lighting load is small. The commercial incandescent circuits are operated at 115 volts, and the residential circuits at 120. In the daytime the station pressure is 115 volts, and as a booster is inserted in the residential circuit, the proper pressure is maintained in the circuits. In the evening, however, the station pressure is 120 volts, and because of the drop, due to the inductive load of the arcs, the pressure remains 115 volts at the incandescent lamps on the commercial circuits, whereas the residential circuit because of the booster, has the same pressure as in the daytime. Although, of course, the potential at the lamps will not be as uniform as with potential regulators, the latter are out of the question because of the expense of installation and the cost of help for operating the same. The circuits, of course, are all overhead.

The overhead system, when taken over by the present company, was in a very bad condition. Eighty-two transformers of all sizes, from five lights up, not exceeding 150 lights in capacity, were connected to the system, in which, however, the two-wire was an unknown quantity. In a great many instances No. 12 B. & S. gauge wire had been used, and this from its own weight had been reduced in some places to No. 14 in size or less. The overhead system, however, in conjunction with the rest of the plant, is gradually being overhauled and rebuilt according to the most advanced practice. The transformers now are but 34 in number, varying from 20 to 1,000 lights in capacity. A three-wire secondary system has been installed in the business districts, at other points several transformers are in parallel, whereas the isolated transformer is used in the outlying districts only. Lightning arresters have been installed, and the secondaries will be fused and the neutral grounded as soon as possible. General Electric oil-insulated transformers are used exclusively. The feeders, of course, are single-phase, although taken from a three-phase bus.

Another department which receives due attention—in fact, far more than is the case in some of the companies in the larger cities, is the meter department. Although, as is self-evident to everyone, it is not wise to give particular attention to one department at the expense of another, nevertheless, when it is considered that the energy consumed on an electric light system at times of light load forms a no insignificant part of the total, and, furthermore, that the revenues received from both are nearly in the same proportion, it is self-evident that too great care cannot be exercised in keeping the meters, as well as the meter department, at a maximum point of efficiency. Thomson recording wattmeters are used, and adjustable field shunt coils are fitted on all of them.

The heating system which was installed in the fall of 1901, in the opinion of the management, is a successful venture, although exact costs cannot be determined until the coming winter. It is the intention to increase this as soon as sufficient additional business can be obtained. At present there are 75 customers who are supplied by 6,000 ft. of mains which extend in a loop around the business section of the town. A total of 60,000 sq. ft. of radiating surface is connected to the system, which is mostly direct, only enough indirect radiation in the form of hot water heaters being installed in each building, that the condensed steam shall not have a greater temperature than 100° before being discharged into the sewers. The cost to the customers is 37½ cents per 1,000 pounds condensation, and a rebate of 10 per cent. is given for the prompt payment of bills within ten days of the first of the month. This discount has been found to be the best incentive for prompt collections, and was introduced, as the rates for heating were established, by the present company, and were so adjusted that the giving of the discount would not prove ruinous, as would be the case with the electric light business. The Holly system of exhaust steam heating of the American District Steam Company is used. As this system is well known, it is not necessary to go into the details of the same. A 10-in. exhaust pipe leaves the power house, and is successively reduced to 8 and 6 in., some 4-in. pipe being used for laterals. An oil separator removes all oil and water of condensation from the exhaust steam before it passes into the heating system. A 4-in. live steam pipe connects with the exhaust main through a pressure-reducing valve, which reduces the steam pressure to 5 pounds or less. In cold weather live steam is required to keep up the required pressure. The exhaust is turned into the heating system whenever the thermometer falls below 55 or 50° F., and the fact that the heat can be turned on in the houses at any and all times when there is any call for it, combined with the attendant cleanliness, etc., has proved an object for a great many to install the system, even though the cost may be somewhat greater than otherwise.

In the Pontiac system there are eight low points from which the water of condensation is removed by means of traps, which in turn are connected to the sewers. The customers' consumption is measured by a condensation meter, which also discharges into the sewer. From an economic as well as from an engineering standpoint, there is no doubt that the investment has proved profitable, and serves to show what can be accomplished in making existing investments still more profitable.

The waterworks were bought from the former bondholders at a receiver's sale in July, 1902. The physical property was in the worst possible condition, the city refusing to pay the rent for hydrants, as the service was entirely unsatisfactory. Unsuccessful attempts had been made to bore artesian wells. The river water, besides carrying a great deal of suspended matter, was unsanitary. When the Pontiac Light & Water Company assumed control, the attempt to bore artesian wells was abandoned, as it was found that the depth would be too great, and for that reason would involve pumping at too great an expense. It was further decided to do away with the old water-

works, doing all the pumping at the power house, although retaining a standpipe at that point. This is 12 ft. in diameter and 125 ft. high, having a capacity of over 100,000 gallons, and under ordinary working condition will be connected with the system. At times of fire, however, this will be cut off by means of an electric valve, located near the stand pipe, so that any desired pressure can be maintained on the mains.

As a result of careful investigation as to the best methods of treating the river water, the system of the New York Continental Jewell Filtration Company was installed. As the power house stands on a high bank, a 6-in. Lawrence Machine Works centrifugal pump driven by a 15-hp, 500-volt compound-wound General Electric motor is used in pumping the water from the river to two 30,000-gallon settling tanks, which are interconnected and so arranged as to allow the blowing off of all impurities which settle to the bottom of the tanks. A 4-in. centrifugal pump is to be installed as a reserve, which will pump 500 gallons per minute. The Jewell iron process of coagulation is made use of in these, the company guaranteeing the removal of 97 per cent. of the bacteria. From the top of these tanks the supply of water for three 500,000-gallon Jewell water filters is drawn, from which the water passes to a storage system, and thence to the pumps. A 7½-hp, 500-volt motor drives a countershaft operating the agitators in the filtering tanks, and a 3-hp motor drives the countershaft operating the centrifugal pump used for the coagulating process. There are eight miles of mains, supplying 310 customers. It is proposed to increase the number of customers by an aggressive and systematic campaign of advertising, calling attention to the wholly unsanitary condition of the well water which is used by a great many of the people. The supply is measured for all customers by meters owned by them, but the make is prescribed by the company. The rates are 25 cents per 1,000 gallons, and a discount depending upon the consumption is allowed on all bills paid before the 10th of the month following the quarter in which the water was used.

A gas plant with an annual capacity of 12,000,000 cu. ft. and provision for doubling that capacity with a holder of 50,000 cu. ft. are being installed at a point near the Chicago & Alton Railroad, as it was not thought advisable to install this near the power house, because of its proximity to the central part of the town. It is expected that all coke will be consumed by the home market, whereas the tar will be shipped to other points. Two solicitors are now at work and 300 customers at least are confidently expected before fall.

As already referred to, it was considered advisable to install the gas plant as well as acquire the waterworks, to prevent another concern from coming in and causing ruinous competition. The waterworks on the one hand would form a very good nucleus for starting an electric light plant and securing the city contract, whereas the gas plant in the hands of outsiders could be made a very formidable competitor. As it is, the gas business can be pushed to advantage in the field peculiarly its own; that is, for fuel, and used with discretion in connection with the electric light business for illuminating purposes. The ownership of the waterworks by those interested in the electric light business certainly has the effect of preventing others from gaining a foothold, which would be far easier in case the public utilities mentioned were not owned by one concern. There is no doubt but that ownership of public utilities by one concern and under one management is not only of benefit to those directly interested in the financial affairs of the company, but under wise management must also result to the good of the public in general.

It is almost impossible in an article of this scope to analyze as thoroughly the elements of success which enter into the successful operation of such a plant as might be desired. We do not look to such plants for the latest and most improved engineering apparatus and methods, but rather to the successful solution of the problem in hand, which consists in getting satisfactory returns on the existing investment, and the securing of a healthy increase in the business under those conditions.

Where Fanning Island Is.

Civil Engineer Werry, who was sent to determine the position of Fanning Island, in connection with the establishment there of a station of the British-Australian cable, has found that the latitude as given on the Admiralty charts is 26 seconds too far north. The longitude, as shown by the charts, is correct.

Statistics of the Massachusetts Electrical Supply Systems in 1902.

By ALTON D. ADAMS.

DYNAMOS at electric lighting stations in Massachusetts had a combined capacity of 84,375 kw on June 30, 1902. These figures represent an increase of 21 per cent. over the like capacity of the previous year. In spite of this increase, the number of dynamos employed stood at 868, representing a loss of 60 machines in the previous twelve months. These movements were due to the general tendency to replace small belted dynamos with much larger direct-connected units, which carried the average capacity of all generators from 74 to 97 kw each.

Changes in the capacities of the several classes of dynamos were very unequal during the year. Arc machines sustained a loss of 18 per cent. and stood at 10,110 kw. Generators used for power purposes only, represented 15,926 kw, a gain of 12 per cent. Dynamos suitable for incandescent lighting gained 35 per cent. in capacity and reached 58,339 kw. From these figures it appears that arc dynamos had 12, power generators 19, and dynamos suitable for incandescent lighting 69 per cent. of the total capacity at lighting stations. Compared with the previous year the arc dynamos had lost 5 per cent. and the power generators 1 per cent., while incandescent dynamos gained 7 per cent. of the total station capacity. The capacity lost by arc dynamos was greater than the gain in power generators, so that the increase of capacity in generators suitable for incandescent lighting was greater than the total increase of the systems. At the rate of shrinkage here indicated for arc dynamos, a few years will see their entire disappearance from electric systems. The obvious cause of this movement is the substitution of enclosed arcs, at constant pressure for interior lighting, and at constant, alternating-current for street service, in the place of series direct-current lamps. Generators of the direct-current type for the supply of power only are employed in some instances to operate railway rather than stationary motors, so that it is impossible to state just how much of the increase in their capacity was applied to either purpose. Dynamos suitable for incandescent lighting, of both the direct and alternating-current types, are now largely applied to the operation of stationary motors, and this fact accounts in part for the marked rise of capacity in this class of machines.

DYNAMOS AT ELECTRIC LIGHTING STATIONS IN 1902.

	Number.	Total kw.	Average kw.
Total	868	84,375	97
Increase	60*	14,941	23
	Arc.	**Incandescent.**	**Power.**
Kilowatts	10,110	58,339	15,926
Increase	2,124*	15,242	1,823
	Arc.	**Incandes't.**	**Power.**
Percentage of total capacity	12	69	19
Loss of percentage	5	7†	1

ENGINES, BOILERS AND WATER WHEELS.

	Number.	Total H.P.	Average H.P.
Engines	327	102,390	313
Increase	17*	13,042	53
Boilers	345	60,593	176
Increase	14*	270	8
Water wheels	43	9,623	224
Increase	1	191	0

* Decrease.
† Gain.

Steam engines, like dynamos, show a rise of total capacity coupled with a decline in numbers during the year. Thus the total number of engines at electric lighting stations was 327, representing a loss of 17, and their combined capacity was 102,390 hp, a gain of 14 per cent. Along with this increase of total capacity came a rise of the average horse-power to 313, or 20 per cent. above that of the previous year. Boilers fell back to 345, a loss of 14 in numbers, but stood at 60,593 hp, showing a small gain of 270 hp in total capacity. This movement raised the average horse-power by 8, or to 176 per boiler. The fact that engine rating exceeded that of boilers by 68 per cent. is accounted for in large part by the practice of allowing an evaporation of 30 pounds of water per hp-hour for boilers, while economical engines operate at a much lower rate of consumption.

A single water wheel was added in the electric light stations of the State during the year, and the total wheel capacity was thus raised to 9,623 hp. Of the combined rating of engines and water

wheels amounting to 112,013 hp, the wheels represented only 8.6 per cent. The total rating of dynamos reduced to horse-power amounts to 112,500, or 9.8 per cent. more than the rated power of engines, but almost exactly equal to that of engines and water wheels combined.

On June 30, 1902, 8,042 stationary motors were connected to electrical supply circuits within the State, and the combined rating of these motors amounted to 34,570 hp. The average horse-power of these motors was 4.2, representing a rise of 0.3 hp each during the year. Motors on circuits operated by power generators fell to 22 per cent. of the total number, a loss of 12 per cent. in twelve months, while motors on circuits operated by dynamos used also for incandescent lighting gained 13 per cent. in relation to the number of all motors and closed the year at 78 per cent. of the total. A single arc motor remains in the field. Boston contained 4,435, or more than one-half of all the motors supplied by electric light stations in the State, and the average capacity of these motors was 4.4 hp each. The total capacity of motors at Boston was 44 per cent. of that for the entire State. The loss in the total number of motors at Boston, as well as the loss of 989 motors from the circuits of power generators throughout the State was due to changes at Boston by which 1,086 motors were dropped from the circuits of power generators in that city. All of the motors at Boston were thus brought into circuits fed by generators that also supply incandescent lamps. As the number of motors operated by power generators decreased 1,086 at Boston, but only 989 for the entire State, it follows that there was a gain of 97 motors of this class outside of that city.

STATIONARY MOTORS CONNECTED TO ELECTRICAL SUPPLY SYSTEMS.

Circuit.	Number.	Gain or loss.	Horse-power.
Arc	1	4*	
Power	1,747	989*	
Incandescent	6,294	1,064†	
Total	8,042	75†	34,570
Motors at Boston	4,435	358*	19,670

* Loss.
† Gain.

TOTAL ARC LAMPS.

	Single open.	Double open.	Enclosed.
Number in state	1,690	6,066	19,292
Increase or decrease	590*	1,721*	3,580†
Number in Boston	137*	....	8,828
Increase or decrease	166*	308*	1,005

* Decrease.
† Increase.

STREET AND COMMERCIAL ARCS.

	Street.	Commercial.	Total.
Number	13,991	12,384	26,375
Loss or gain	89*	1,165†	1,076
Percentage of total	53	47	....

* Loss.
† Gain.

Conquest of the arc lighting field by enclosed arcs has gone rapidly forward during the year, as may be seen by the gain of 3,580 in the number of this type of lamp; while single open arcs lost 590 and double arc lamps, 1,721 of their number. At the close of the fiscal year, the electric lighting systems included 1,690 single open lamps, 6,066 double lamps and 19,292 enclosed arcs. Owing to the fact that not all of the lamps included in the electric systems are in use at any one time, the total number of these arc lamps, 27,048, was greater by 673 than the sum of public and commercial arcs. The street or public arcs stood at 13,991, having decreased in number by 89 during the year, but commercial arcs made a gain of 1,165 and closed with 12,384, showing a net gain of 1,076 for all arc lamps in use. Of these lamps 53 per cent. were devoted to public and 47 per cent. to commercial service.

Arc lamps continue to be rated at nominal candle-powers that range from 500 to 4,000, besides ampere ratings of 1 to 20 in the case of enclosed arcs. For public lamps the rating by nominal candle-power is still the favorite method, all save 459 of these lamps being so rated. Commercial lamps are more commonly rated according to the amperes taken, 64 per cent. of their number being on this basis. Among commercial arcs, 5 amp. was the most frequent rating, 31 per cent. of their total number having been of that capacity, while 2,000-cp lamps followed with 19 and 1,200-cp lamps with 15 per cent. Of the public arcs 45 per cent. were rated at 1,200, and 51 per cent. at 2,000 cp.

Commercial incandescent lamps were rated at 2 to 150 cp each, and their total number was 1,305,473 on all the lighting systems of the State. Of this number, 98 per cent. was made up with nominal 16-cp lamps, and there were only 3,576 lamps of all higher candle-powers. The tendency to use lamps of less than 16 cp rating was very slight, the largest number in any one size being 5,430 lamps of 10 cp. The total number of commercial incandescent lamps rose 16 per cent. during the year.

Incandescent street lamps like those in commercial service were mainly rated at a single candle-power, but this rating for the street lamps was 25 instead of 16 candles. Of the 20,101 incandescent street lamps, 74 per cent. were of the nominal 25-cp size, and 32-cp lamps followed with 10 per cent. of the total number. Unlike arc street lamps, the incandescents increased in numbers during the year, the rise amounting to 9 per cent. of their number at the beginning. These incandescent street lamps have been shifted in the main from constant-pressure alternating and constant direct-currents circuits to lines operated by constant-current transformers.

PUBLIC ARCS RATED IN CANDLE POWER.

Candle power.	Number.	Candle power.	Number.
1,200	6,312	1,600	26
1,500	2	2,000	7,170

PUBLIC ARCS RATED IN AMPERES.

Amperes.	Number.	Amperes.	Number.
5.5	320	6.6	139

INCANDESCENT STREET LAMPS.

Candle power	15	16	20	24
Number	216	158	854	414
Candle power	25	30	32	40
Number	14,950	869	2,036	546
Candle power	50	64	65	75
Number	23	17	17	1

COMMERCIAL ARC LAMPS.

Candle power	500	600	800	1,200
Number	1	5	16	2,085
Candle power	1,500	1,600	2,000	4,000
Number	2	60	2,306	6

COMMERCIAL ARC LAMPS.

Amperes	1	3	4	5	6	6.8
Number	1	540	1,103	3,842	1,656	108
Amperes	6.6	7	10	15	20	..
Number	17	456	43	2	1	..

COMMERCIAL INCANDESCENT LAMPS.

Number	152	751	984	3,851	5,430
Candle power	2	4	6	8	10
Number	2,293	1,288,284	2,338	486	25
Candle power	12	16	20	24	25
Number	6	648	43	1	29
Candle power	30	32	50	65	150

CAPACITIES OF CONNECTED LOADS.

Load.	Kilowatts.	Percentage of total.
Arc street lamps	6,234	5.1
Incandescent street lamps	1,830	1.6
Commercial arc lamps	5,599	4.6
Commercial incandescent lamps	72,871	60.0
Electric motors	34,570	28.5
Total	121,101	99.8

To determine the total capacity of loads connected to the circuits of electrical supply systems, each kind of apparatus has its rating reduced to a kilowatt basis. For this purpose, it is assumed that the full load efficiency of all motors is 74.6 per cent., so that one kilowatt must enter the motors as electric power for each mechanical horse-power delivered. With arc lamps rated at nominal candle-powers, 0.25 watt has been taken as the rate of consumption per candle-power. Arc lamps rated in amperes are assumed to operate with 80 volts each. All incandescent lamps of both the street and commercial sorts have been computed on the basis of 3.5 watts per nominal candle-power.

ENERGY INCOME PER KILOWATT CAPACITY OF CONNECTED LOAD.

Loads.	Kilowatts.	Dollars income.	Dollars per kw.
Arc street lamps	6,231	1,410,812	233.
Incandescent street lamps	1,830	353,364	195.
Motors	34,570	921,786	30.
All commercial lamps	78,470	3,721,284	47.42
Total	121,101	6,578,598	54.

From these computations it appears that the total capacity of lamps and motors connected to electrical supply systems amounted to 121,101 kw, or 14 more than the corresponding load of the previous

year. Of the total capacity of dynamos at electric lighting stations, in 1902, the connected load was 143 per cent. Commercial incandescent lamps made up 60 per cent. of this load, having gained 1 per cent. in their relation to total capacity during the year. Electric motors represented 28.5 per cent. of the connected load and had lost 1.2 per cent. of its total in the preceding twelve months. Other items in the load each varied less than one per cent. as to its total when compared with those of 1901.

The year under review shows an increase of 5 per cent. in the number of poles included in electrical supply systems, and closed with this number at 116,004, of which 110,942 were set in public streets and 5,062 elsewhere. Meantime the length of underground conduit went up 11 per cent. to 1,257,855 ft., or 239 miles. At 50 poles per mile, the number just named corresponds to 2,320 miles of line, or ten times the length of underground conduits. The underground conduits contained 8,968,798 ft. of wire, or an average of 7.1 wires per conduit. The length of conduit added during the year was 25 miles, and of pole line, at 50 poles per mile, 120 miles.

Electrical supply systems within the State were operated by 66 companies that did only electric business, and by 24 gas companies during the year. The sum of stocks, bonds and notes outstanding against the companies may be taken as an approximate measure of their investments. This sum was greater by $6,267,190 for all the gas companies of the State than for the purely electric companies, but the electric assets of the gas companies stood at the sum of $4,064,594, so that the total investment in electrical supply was probably greater than that in all the gas systems. Extensions of the purely electric companies have been provided for by an increase of 8.4 per cent. on the face value of their stocks, 7.2 per cent. on their bonds, and 8.4 per cent. on notes payable. Comparing the electric assets of the gas companies with the assets of the purely electric companies, it appears that the latter have made 86.1 per cent. of the total investment in systems of electrical supply.

The surplus of all the companies doing a purely electric business amounted to 14.1 per cent. of their capital stocks at the close of the year, but the actual amount of this surplus was 28.1 per cent. less than that of 1901. Gross income of all electric lighting systems by whomsoever operated amounted to $6,642,309 for the year, representing a gain of 9.1 per cent. over the like income for 1901. Of the income named, 99.0 per cent. was derived from sales of electrical energy, and 1.0 per cent. from the rent of motors, meters and fixtures, and from steam heating. Operating expenses of all electrical supply systems amounted to 62 per cent. of their earnings, leaving a gross profit of $2,532,493. Of this profit the gas companies earned 18 per cent., leaving $2,142,920 for the purely electric companies. Incomes of the last-named companies from jobbing and rents of buildings brought their gross profit up to $2,563,758, or 12 per cent. on their investments, measured by the sum of stocks, bonds and notes. Of the gross profits just named, interest absorbed 13.5, dividends 47, depreciation charges 10.2 and sundry items 39.6 per cent., resulting in a deficit. The sum of dividends was $1,207,458, or 8.7 per cent. on capital stocks. Depreciation charges amounted to only $262,086, or 1.2 per cent. of the face value of stocks, bonds and notes, or 1.3 per cent. on the value of the assets of electric companies. These charges left a deficit of $269,714 in operations for the year.

The income of electrical supply systems was 87.3 per cent. of that derived from the sale of gas throughout the State, but gas street lamps earned only 9.8 as much as the electric.

Of all sales of electrical energy, that for commercial, arc and incandescent lamps by meter was the most important, and yielded 46 per cent. of the total energy income. Next in importance came the service to arc street lamps, which furnished 22 per cent. of the energy income. Sales of current for power purposes yielded 15.9 per cent. of the income, a gain of 1 per cent. over the previous year. Commercial incandescent lamps at contract rates earned only 3.5 per cent. of the total income, and commercial arc lamps on contract rates were credited with 6.8 per cent. of this total. Incandescent street lamps earned 5.4 per cent. of the energy income, or one-fourth as much as the arc street lamps. Arc and incandescent street lamps combined earned 27.4 per cent. of the entire energy income, or 1.2 per cent. less of this total than in the previous year.

Of the $4,109,816 expended in the operation of all the electrical supply systems during the fiscal year of 1902, 53.4 per cent. was represented by the outlay at the electric stations, 18.7 per cent. by the cost of distribution, 13.1 per cent. went for offices and management, and 14.6 per cent. for miscellaneous expenses. The total of these expenses was 4 per cent. greater than that of the previous year. Fuel represented 48.4 per cent. of the entire expense at electric stations, and 22.8 per cent. of all operating expenses for electrical supply systems. The other items of expense at electric stations were made up of wages, 27.4 per cent.; rent of real estate, 4.4; steam plant repairs, 6.5; electric plant repairs, 4.9; station repairs, 2.4; water, 2.8; oil and waste, 2.1, and apparatus and machinery, 0.7 per cent. of the total there.

Taxes paid on all the electrical supply systems by whomsoever owned amounted to $341,822.87, and this sum is only 1.1 per cent. of the value of all assets of electric companies, plus the value of electric assets of the gas companies, according to their own statements. Current bought by electrical supply systems amounted to $33,672, a sum greater by 56 per cent. than that of the previous year, showing the tendency to trade between the various companies and with electric water power plants.

Percentages of energy income from each load:	
Commercial arc and incandescent lamps by meter	46.
Arc street lamps	22.
Motors	15.9
Commercial incandescent lamps by contract	3.5
Commercial arc lamps by contract	6.8
Incandescent street lamps	5.4
All street lamps	27.4

Arc street lamps yielded an income during the year of $1,410,812, or $233 per kw of capacity in those connected to the systems. Incandescent street lamps come next in relative income with a total of $353,364, or $195 per kw of their capacity. The income per kilowatt from arc street lamps shows a decline of $13 and the like income from incandescent street lamps $18, compared with corresponding figures of the previous year. From all commercial lamps, both arc and incandescent, the income was $3,721,284, or $47.42 per kw capacity, in 1902, this income per kilowatt being more than $4 below that of 1901. In the case of motors the entire income amounted to $921,786, or $30 per kw of capacity, this latter sum being $1 greater than that of the previous year. These incomes per units of connected capacity seem to indicate a general reduction in prices for electrical energy as represented by $54 per kw capacity, in 1902, instead of $58 as in 1901.

Five of the electric supply companies did not earn enough to pay operating expenses during the year, and twenty-five more of the companies paid no dividend. The largest dividend paid was 50 per cent. on capital stock in the case of a company that sold its plant and went out of business. Two companies paid dividends of 10, and nine companies 8 per cent. on stocks.

Death of Edward Tremlett Carter.

We regret to report the death of Mr. Edward Tremlett Carter, editor of London *Electrician*, which occurred at Cleveden, Somerset, April 17. Mr. Carter, who was born at Calcutta, April 26, 1866, was educated at Bristol, privately, and at Merchant Venturers' College, and afterwards at University College. On completing his engineering studies under Profs. S. P. Thompson and H. S. Hele-Shaw, at University College, Bristol, Mr. Carter, in 1885, was appointed lecturer at the School of Electrical Engineering, Hanover Square, London, at that time the only school in the world having a fully organized electrical engineering course. While on the staff of this institution, he organized courses of lectures and practical training in mechanical engineering, machine design and other branches of engineering. One of these courses subsequently appeared as a series of articles in the *Electrician*, and afterwards in book form, entitled, "Motive Power and Gearing for Electrical Machinery." During the eight years he remained at the school he engaged in practice as a consulting engineer, and also contributed numerous articles to the *Electrician*. In 1893 he joined the editorial staff of that journal under Mr. A. P. Trotter and in 1897 was appointed editor of that journal, a post which he has retained until the present time. Mr. Carter was a member of the Institution of Electrical Engineers and of the Société des Ingenieurs Civils de France; also a Fellow of the Royal Astronomical Society and of the Physical Society of London. About 1897 Mr. Carter paid a visit to the United States, and the many acquaintances he made here at that time, as well as other Americans who have experienced his hospitality in London, will regret his untimely decease.

Centralized Management of Electrical Properties.

By H. S. Knowlton.

AMONG the powerful economic changes which differentiate the present from the past in industrial life, few are of greater importance than the development of the trust and syndicate principles of property ownership. The tendency of the times is a combination of interests whose objective point in the last analysis is always a greater financial return per unit of investment. This is derived by either limiting or annihilating competition, reducing operating expenses and possibly fixed charges, or by a concentration of property management in a few responsible hands, the identity of the different systems remaining intact. The absence of competition defines the trust principle; and its existence, or non-suppression, the syndicate. It is impossible in the scope of this article to discuss the trust problem, and impracticable to treat the syndicate question with that thoroughness which it deserves, but as far as space permits, I shall attempt to note down some of the essential features of centralized management as they apply to the control of electric railway and lighting properties existing in the United States to-day.

The industrial progress of the last century has converted many former luxuries into necessities so vital in their relations to our daily life that the advance of civilization itself would be stayed if they were taken away. Substitute the horse in place of electric motive power in city transportation, and the imagination demands no further illustration. Upon this fact rests the foundation of success—the output of the electric property being an imperative necessity of civilization in urban communities. If the system is managed on scientific principles, with honesty and fair dealing practiced by both consumer and operator, a long step has been taken toward financial prosperity.

It would be difficult to name any city in this country which is to-day a stranger to the incandescent lamp and the electric car. It is far easier to discover electric systems which are burdened with antiquated apparatus, and so inefficiently operated that dividends are meagre or conspicuously absent. The tremendous electrical developments of the last quarter century are in the main responsible for this. Operating economy and the progressive applications of a newly developing science seldom travel together, and in the first enthusiasm of electrical progress it is not surprising that little attention should have been given to the expert analysis of financial and operating efficiency. In the last decade, however, the elimination of losses has gradually been given increased attention, and the centralized management of properties has naturally followed.

In order properly to estimate the advantages of centralized control, it is desirable to understand something of the controlling organization itself. It is essential that the combination which operates the property include in its make-up highly specialized ability of at least four kinds—financial, executive, technical and tactical. It must, further, be in close touch with a syndicate of banking houses or capitalists of recognized standing, and may or may not occupy the same offices with them. Its headquarters are preferably located in one of the great money centers of the country, as its work demands every facility for the swift transaction of business which modern labor-saving methods can produce. In the office organization the subdivision of labor will depend largely upon the number and character of properties managed, and the employees will vary from less than a score to several hundred.

Broadly speaking, a large managing concern may be divided into at least three departments in its controlling offices: executive, operating and engineering. Although the functions of these separate divisions will at times overlap, the work of the concern is usually parcelled out to that particular branch of the office which can dispose of it most efficiently. Sub-departments for the handling of mail, telegrams and express matter, the purchase of all kinds of apparatus and supplies, the preparation of drawings, filing of records, statistics and data, the auditing and keeping of accounts, management of securities, etc., will all play an important part in the conduct of the concern's affairs. In each one of these departments the work will be divided further among specialists most qualified to perform it, so that in the last analysis each piece of work receives the attention of an expert in some particular field, and is seldom carried through in detail by the "all-around" type of man which a single property requires when managed from within itself. Thus, in the engineering department all questions arising in any of the properties in regard to the capacity of railway motors and distributing systems for given schedules and services will be referred to an engineer who is a qualified expert in that class of problems, and the organization's decisions in those matters will be largely based upon his figures. In like manner, the legal department will refer questions of power contracts to a particular man whose knowledge of that subject is special.

It is thus apparent that a rightly managed centralized body can offer to the smallest and most scattered properties advantages in operating control which are impossible to any but the largest city companies. The expense of concentrating and maintaining a staff of experts at headquarters is far less burdensome to the coalesced organization than even a much smaller corps of specialists would be to the individual company. The various common operating supplies can frequently be purchased in bulk with great economy, and the operation of each property can be watched with microscopic eye. Data of the utmost significance is constantly flowing into headquarters from the outside plants, and an exhaustive analysis of the operating results in toto and per unit of output often yields comparisons which can be the means of saving hundreds or thousands of dollars in yearly operating cost. By plotting the financial and operating figures of the different properties from week to month in graphic diagrams, the presence of any unusual variation in conditions can be immediately detected, and at once attacked by the solvent of expert analysis.

When the various properties are located in widely differing sections of the country, the field of investigation and possible reduction of wasteful expense is almost limitless. It is safe to say that no growing property remains in, if indeed it ever reaches, the happy state in which no further improvement in expenses or methods is possible. Few managers of individually controlled systems have either the time or facilities to make anything like the detailed comparative analysis of depreciation, power losses, idle capital invested, etc., which are possible to the trained dissectors employed by the progressive controlling organization.

The card catalogue, correspondence, data and record-filing systems of the headquarters office should be as nearly perfect in their adaptation to the accurate and prompt transaction of business as human skill can make them. A well-equipped and maintained technical and commercial library is inseparable from the highest efficiency in the active management of the properties. Nor should the collection and classification of reliable data from other properties than those controlled by the concern be lost to view. It should frequently send its experts to examine new and instructive installations and systems, and thus prepare itself to take prompt advantage of any improvement in apparatus and methods which can be applied at home. The expense of such examinations will be justified in the long run by the progressive work which will be accomplished, and there will be little room for methods to become fossilized. From time to time special investigations of the financial economy of the property investments in proportion to the business done should be made, apart from the data furnished by the operating reports.

An important phase of such an organization's work is the reception of business propositions from the four quarters of the globe in regard to new electrical or other industrial developments to be financed and operated. The data which the management obtains from its own properties is thus of great use in judging the prospects of others, and the larger the field of control, the broader is the range of possible prediction. Consequently, as new properties are taken on, the efficiency of the financial analysis should be much increased.

It is doubtless true that the centralized control of a property hundreds or even thousands of miles from the headquarters office would be unsuccessful without the services of a resident manager. Countless situations arise each week which demand the presence of a strong personality acting in the home organization's interests. Such a representative must be a picked man, diplomatic, resourceful, with sound business ability, common sense and a good general knowledge of the technical phases of the work. Standing between the controlling power and the public, alive to every possibility of obtaining new business, extending the company's influence, and, above all, keeping the system in motion, he will find little time to devote to the detailed analysis practiced by the centralized body's financial experts. The importance of the latter in higher economies of operation is thus the more apparent.

It is certain that securities of any property operated by a centralized management possess a stability in value which is not found in the case of a system controlled by a single individual, whose death or mental disability may bring untold disaster upon the property through

the incompetence or heedlessness of heirs and assigns. Again, the controlling management should have a vital financial interest in so developing and operating the property that its value is constantly being increased, and it should confine itself to operation and development apart from the business of buying and selling securities used merely as objects of speculation and barter.

In estimating construction and operation cost, the liberally conducted property management has an immense advantage over the singly operated company. Knowing as it should the detailed cost of every system which it controls, it is in a position to estimate the cost of new work with unusual accuracy. A further advantage arises in the comparison of previous quotations by contractors and manufacturers with present figures submitted.

Finally, efficient centralized management requires a considerable amount of traveling per year by certain experts of the headquarters office. In every case where complete data cannot be obtained by correspondence, or wherever a personal trip from the executive office to the property will positively throw additional light upon the local conditions, such a trip should be made. The data used in making financial estimates and analyses should always be the best obtainable at any cost consistent with the permanent economy of the work, or serious losses will follow.

Considered broadly, centralized control with a resident manager, therefore, appears the condition of greatest success in the operation of many existing electric properties, and the further development of this method will undoubtedly continue to attract the increasing interest of the industrial economist of the twentieth century.

Enclosed Arc Lamp Statistics—Records of Thirty Central Stations.

BY L. B. MARKS.

IN an article on "Enclosed Arc Lamp Statistics," contributed to these columns in the issue of November 4, 1899, data were given by me showing the number of open and of enclosed arc lamps in use in 1895, 1896, 1897, 1898 and 1899 respectively on the circuits of thirty-six of the lighting companies holding membership in the Association of Edison Illuminating Companies.

The records in the following table are supplemental to those given in the article above referred to and contain the data submitted to me in March, 1903, by thirty companies, as follows:

Georgia Railways & Electric Company, Atlanta, Ga.; Edison Electric Illuminating Company, Boston, Mass.; Edison Electric Illuminating Company, Brockton, Mass.; Edison Electric Illuminating Company, Brooklyn, N. Y.; Buffalo General Electric Company, Buffalo, N. Y.; Canton Light, Heat & Power Company, Canton, Ohio; Chicago Edison Company, Chicago, Ill.; Columbus Edison Company, Columbus, Ohio; Edison Electric Illuminating Company, Cumberland, Md.; Edison Illuminating Company, Detroit, Mich.; Elgin City, Chicago & Alton Railway Company, Elgin, Ill.; Edison Electric Light & Power Company, Erie, Pa.; Jackson Light & Power Company, Jackson, Mich.; Minneapolis General Electric Company, Minneapolis, Minn.; New Orleans Railways Company, New Orleans, La.; New York Edison Company, New York, N. Y.; Paterson & Passaic Gas & Electric Company, Paterson, N. J.; Piqua Electric Company, Piqua, Ohio; Metropolitan Electric Company, Reading, Pa.; Rochester Gas & Electric Company, Rochester, N. Y.; Missouri Edison Electric Company, St. Louis, Mo.; St. Paul Gas Light Company, St. Paul, Minn.; San Francisco Gas & Electric Company, San Francisco, Cal.; Edison Sault Electric Company, Sault Ste. Marie, Mich.; Washington Water Power Company, Spokane, Wash.; Syracuse Lighting Company, Syracuse, N. Y.; Toledo Railways & Light Company, Toledo, Ohio; Potomac Electric Power Company, Washington, D. C.; Connecticut Railway & Lighting Company, Waterbury, Conn., and Wilmington City Electric Company, Wilmington, Del.

City.	Open arcs.	Enclosed Arcs.	Remarks.
Atlanta, Ga.	....	1,850	Street lamps d. c. series enclosed—displaced d. c. series open; commercial a. c. multiple service.
Boston, Mass.	100	8,000	Street lamps d. c. series enclosed; 4,050 series lamps—displaced d. c. series open. Includes Boston Elec. Lt. Co. and Suburban Lt. & Pr. Co.
Brockton, Mass.	....	790	
Brooklyn, N. Y.	4,140	4,970	Street lamps d. c. series open and d. c. multiple enclosed; 3,380 series open arcs.
Buffalo, N. Y.	....	6,700	Street lamps d. c. series enclosed—displaced d. c. series open.
Canton, O.	....	555	Data Dec. 31, 1902. Street lamps (349) d. c. 6.6 ampere series enclosed; store lamps d. c. multiple and d. c. series enclosed.
Chicago, Ill.	2,292	10,182	Street lamps d. c. series open.
Columbus, O.	803	836	Open arc service d. c. series.
Cumberland, Md.	100	150	
Detroit, Mich.	....	1,469	
Elgin, Ill.	....	320	
Erie, Pa.	....	1,110	Street lamps all d. c. series enclosed (700)—displaced d. c. series open.
Jackson, Mich.	250	190	Open arcs are all street lamps d. c. series; enclosed arcs are store lamps multiple a. c.
Minneapolis, Minn.	1,215	2,275	Open arcs all d. c. series; 922 of these for street lighting.
New Orleans, La.	1,874	1,860	Open arcs all d. c. series. New Orleans Railways Co. and Edison Electric Co. Consolidated.
New York, N. Y.	1,138	12,422	Statistics for Borough of Manhattan only.
Paterson, N. J.	1,023	1,145	All but 56 of the open arcs are d. c. series.
Piqua, O.	135	125	
Reading, Pa.	700	750	Open arcs d. c. series.
Rochester, N. Y.	2,262	2,468	Open arc d. c. series street service. Company writes April 3, 1903, "The past year we have taken another Company into our fold and they had a great many open arcs."
St. Louis, Mo.	65	2,915	Enclosed arcs a. c. multiple.
St. Paul, Minn.	....	1,949	396 street lamps a. c. series enclosed; 140 a. c. multiple enclosed and 1,413 d. c. multiple enclosed arcs on commercial circuits.
San Franc., Cal.	1,500	2,800	Street lamps d. c. series open.
Sault Ste. Marie, Mich.	....	247	Street lamps a. c. series enclosed. Store lamps a. c. multiple.
Spokane, Wash.	399	699	Open arcs are d. c. series. Company writes March 31, 1903, "We are now displacing 275 T-H open arc lamps by 7½ ampere series alternating enclosed arc lamps."
Syracuse, N. Y.	1,325	925	All open arcs 9⁶/₁₀ ampere d. c. series street lamps; 125 a. c. series enclosed on commercial circuits.
Toledo, O.	869	315	Street lamps only, reported; of these 315 arc a. c. series enclosed.
Washington, D. C.	....	2,394	1,066 street arcs of which 569 are series d. c. enclosed, which displaced d. c. series open; balance multiple d. c. enclosed.
Waterbury, Conn.	512	414	Open arc lamps d. c. series.
Wilmington, Del.	476	559	All but 53 of the open arcs are d. c. series.
Total	21,178	71,384	

In the table, series (constant-current) high-tension arc lamps are referred to simply as "series," direct-current lamps as "d. c.", and alternating current as "a. c."

Of the 21,178 open arcs connected to the circuits of these companies in 1903 about 4,250 are multiple lamps, the balance being series. Of the 71,384 enclosed arcs, about 11,000 are series lamps, the balance being multiple. The vast majority of the multiple lamps, enclosed and open, are operated on 110 to 120-volt direct-current constant potential circuits.

The comparative use of open and of enclosed arc lamps by these companies since 1895 is graphically represented in the accompanying chart.

Referring to the open arcs, the unbroken lines represent multiple lamps and the dotted lines direct-current series lamps. Attention is called to the fact that the statistics for the years 1895-6-7-8 do not include series arc lamps, and hence for these years the chart shows the comparative use of multiple lamps only. This limitation, however, does not apply to the years 1899 and 1903, for which the records include all of the lamps connected to the circuits of the companies.

It will be noted from the chart that the number of arc lamps connected to the circuits of the companies in 1903 is almost double that of 1899. Part of this increase is due directly to the absorption of

or amalgamation with, other lighting companies, during the past four years. Thus, for example, since my report of November 4, 1899, the Edison Electric Illuminating Company, of Boston, has absorbed the Boston Electric Light Company and the Suburban Light & Power Company, of Boston. Just how many lamps were taken over by the companies as a result of these consolidations, I am unable to say, but the statistics account for at least 3,000 series open arcs thus acquired. Hence, although from the chart it would appear that there has been no substantial decrease in use of series open arcs since 1899, as a matter of fact the records show that over 4,000 of the series open arcs reported by the companies in that year have since been displaced by series enclosed arc lamps.

Most of the street lighting is done by series lamps and the bulk of the indoor lighting by multiple lamps. In thirteen of the cities the street arcs are direct-current series open; in five, direct-current series enclosed; in three, alternating-current series enclosed; and

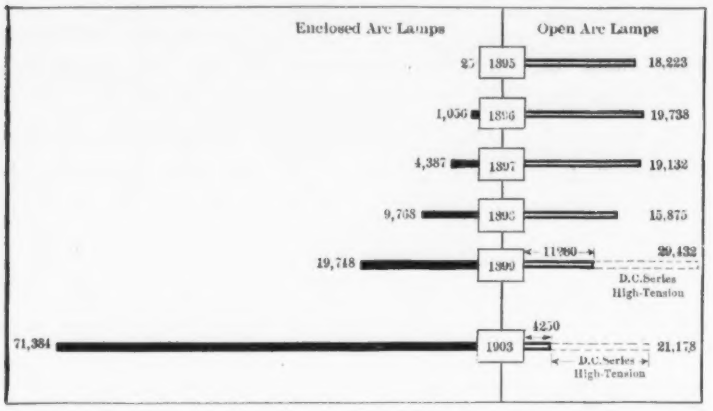


CHART SHOWING COMPARATIVE USE OF OPEN AND ENCLOSED ARCS.

in three, direct-current multiple enclosed. In ten of the cities the companies have no open arcs whatever on their circuits.

Although the above figures include only a small proportion of the total number of lamps used in this country, the records may be said to fairly point out the trend of arc lamp practice in the United States. In general the following conclusions may be drawn from the statistics:

1. The enclosed arc lamp has not only largely displaced the open arc, but has greatly extended the field of arc lighting.

2. The multiple open arc lamp is rapidly going out of use. The series open arc is still used a considerable extent for street lighting, but is being gradually displaced by the series enclosed arc lamp.

Remarkable Development in Light and Power in Chicago.

In view of the visit of the National Electric Light Association to Chicago next week, the annual reports of the Chicago Edison and Commonwealth Electric Companies just issued are more than usually interesting. They show what can be done in a great city under able and progressive management, especially where a unification of plan has been made effective over a large area. From time to time these pages have illustrated and described very fully and exhaustively the successive developments of the Chicago Edison system, including various articles during the present year, and we now give the financial results of the past year, indicative of the brilliant success of the engineering and economic policies adopted.

Net earnings of the Chicago Edison Company in the fiscal year ended March 31 were $1,213,929. The amount left after the deduction of bond interest was $912,939, which figures 10.6 per cent. on the total amount of stock outstanding and the advance payments for new stock to be issued in November and about 12 per cent. on the average amount of stock outstanding for the year.

The surplus account was increased nearly $180,000 after $90,000 had been written off for depreciation and $8,000 for insurance reserve.

The company's totals increased during the year nearly $2,000,000. Two increases in the stock were authorized, the second installment not having been delivered as yet, although nearly all of the subscription money has been paid in. The money has gone into extensions and improvements of the company's plants.

INCOME ACCOUNT.

	1903.	1902.
Gross income from electric current and mdse. sales	$3,409,576	$2,806,609
Operating, repairs, renewals and general expense	2,195,646	1,720,820
Net income all sources	$1,213,929	$1.085,789

CHARGES AGAINST INCOME.

	1903.	1902.
Interest on bonds and debentures	$300,990	$300,983
Dividends paid	593,346	515,982
Balance	$319,593	$268,824

The balance sheet as of March 31:

ASSETS.

	1903.	1902.
Plants, real estate and franchises	$14,230,840	$12,766,540
Material and unfinished work	388,025	405,494
Accounts and notes receivable	784,465	358,997
Cash	136,035	121,033
Total	$15,539,365	$13,652,064

LIABILITIES.

	1903.	1902.
Capital stock:		
Stock issued	$7,589,500	$6,899,900
Advance payments for new stock authorized	997,187	.....
Fractional scrip	170	.....
Total stock	$8,586,857	.....
Bonds and debentures	5,508,000	$5,508,000
Accounts payable	123,859	140,336
Depreciation reserve	590,000	500,000
Insurance fund	68,000	60,000
Surplus account	610,084	431,077
Open account	52,565	112,751
Total	$15,539,365	$13,652,064

The Commonwealth Electric Company, which is the associated organization and is owned outright by the Chicago Edison Company, made a remarkable increase in earnings in the fiscal year ended March 31. Its net income from all sources increased nearly 40 per cent. to $378,821, and after the payment of largely increased bond interest there remained for the surplus account $158,000, or 3.16 per cent. on the stock.

This is by far the best showing the company ever made. The company's balance after bond interest in its first year ended March 31, 1899, was $25,155. It has increased steadily every year since then till the total amount of undivided profits carried in the balance

The financial statement for the year ended March 31 compares as follows with that of the preceding year:

	1903.	1902.
Gross income from electric current and merchandise sales	$1,002,085	$769,666
Operating repairs and renewals and general exp.	623,264	497,903
Net income from all sources	$378,821	$271,763
Interest on bonds and debentures	220,705	167,261
Balance	$158,116	$104,502

The comparative balance sheets follow:

ASSETS.

	1903.	1902.
Plants, real estate and franchises	$10,292,883	$8,914,599
Material in storeroom and unfinished work	159,417	107,577
Accounts and notes receivable	126,216	108,637
Cash	164,372	157,759
Open accounts	11,079	15,393
Total	$10,753,968	$9,303,965

LIABILITIES.

	1903.	1902.
Capital stock	$5,000,000	$5,000,000
Bonds and debentures	4,950,000	4,000,000
Accounts payable	382,124	40,237
Undivided profits	421,844	263,728
Total	$10,753,968	$9,303,965

sheet equals $421,000, or 8.4 per cent. on the capital stock. The company had never paid any dividends. The stock was given as a bonus with the bonds.

During the year the Commonwealth Company increased its bond issue $450,000. Some of these bonds were placed in Chicago and some in London. The balance sheet shows a large increase in the amount of bills payable owing probably to the active new construction work.

Rectification of the Alternating Current by Means of the Electric Arc.

It is interesting to note that some of the phenomena involved in the Cooper-Hewitt static converter were studied by MM. Jamin and Maneuvrier as early as 1882. The *Lumiere Electrique,* of July 18, 1882, contains an abstract of a paper on the subject which appeared in the *Comptes Rendus,* of June 12, 1882, the abstract being prefaced by a note signed with the initials of the editor, Count du Moncel.

The note states that the writer had witnessed some interesting experiments made by MM. Jamin and Maneuvrier in which it was shown that when an alternating current is passed through an aerform medium between electrodes of unequal mass and surface, current of one sign predominates, the result being a differential current very energetic in its action and having the property of a unidirectional current. It is stated that this effect does not seem to be connected with a similar one that has been noted with respect to a Ruhmkorff coil, but appears to have its cause the dissymmetry of the electrodes, the value of the current being dependent upon the nature of the larger electrode. A maximum effect is obtained with mercury and copper and a minimum with iron. The differential current always passes from the larger to the smaller electrode. The electrolytic effects produced by this current are very energetic, but it is necessary in every case that an arc be formed between the two electrodes.

The paper by MM. Jamin and Maneuvrier in the *Comptes Rendus* opens by stating that the machine employed in the experiments normally produces a symmetrical alternating current, and consequently would not decompose water nor affect a tangent galvanometer in circuit. This condition does not change if the current passes through a circuit containing several arc lights, provided that the two carbons of the lights are equal, identically arranged and have the same temperature. If, however, there is placed in circuit with the alternating current a lamp having carbons unequal in cross-section, the two components of the current from the machine cease to be equal; that which passes from the large to the small carbon, from the electrode of greater to that of lesser temperature, predominates. It attains a maximum between a large electrode of gas retort carbon which is heated but slightly, and a carbon pencil terminating in a fine point and which attains a high temperature. The same phenomenon is produced in the same sense when an arc is made to pass between any metal and a carbon point. In general, the predominating current is feeble or lacking when the arc is short, and increases with the distance between the electrodes. With zinc it is at first as intense as with copper, but drops suddenly, probably owing to the formation of oxide, with which the zinc soon becomes covered. The paper gives a mathematical discussion with relation to the two factors of mean e.m.f. of the differential current, and the resistance introduced into the circuit by the arc formed. The conclusion is that carbon, iron and lead offer the greatest resistance and copper and mercury the least.

An account of some experiments is then given, in which a direct current was passed, first between electrodes of carbon and mercury, next between mercury and carbon; in the latter case the arc had a pronounced green color and the metal was volatilized energetically; in the other case the arc was reddish in color and there was a less abundant production of vapor. This renders evident the dissymmetry which occurs when an alternating current is passed, the arc then being green, which proves that the current which passes from the mercury to the carbon predominates over the current which passes in the opposite sense; and since there is no difference in the resistance of the arc, it is necessary to seek a particular property of alternating currents to arrive at a reason for the action.

Each of the currents contain at the moment when they commence to flow, a certain sum of energy which becomes free when they cease and gives rise to a current in the opposite sense; or, according to Edlund, to a counter e.m.f. Thus one component at first very feeble, increases little by little and when it ceases gives rise to an inverse action which assists the other component developed by the machine at the same moment. If, then, the first component offers a smaller reaction than the second component, it will be less enfeebled and more reinforced and will determine the direction of flow. Whatever may be the explanation, it is clear that an arc once produced at a mercury surface, the differential current engendered entirely changes the action of the generators; and that one of the systems of currents, if not entirely extinguished, is at least considerably weakened, and the other system consists of successive currents of a greater strength and duration. The introduction of such arcs thus rendered the machine experimented with, which otherwise is incapable of decomposing water, to have the effect of a primary battery equivalent to 100 Bunsen cells; and like a primary battery, the effect can be employed in electrochemical processes, to magnetize soft iron, reduce metals, transmit power—in short, replace a direct-current machine in all of its applications.

The paper concludes by a statement that alternating-current machines of the day are only applicable to the production of light, all attempts having failed to render such machines by means of a rectifier applicable to electrochemical purposes. From the above it is seen, however, that a rectifier can be replaced by one or several arcs formed between a bath of mercury and a carbon point. In conclusion it is stated that the economic conditions of this transformation remain to be determined.

Electricity on Trunk Lines.

In the current issue of the *North American Review,* Mr. C. L. De Muralt contests the opinion of Mr. Cornelius Vanderbilt that while it is possible, from an engineering standpoint, to adopt electricity as the motive power for trunk railway service, yet from the financial point of view the change is not possible. Mr. De Muralt discusses all of the various factors involved and then considers specifically the cases of the Pennsylvania and New York Central railroads.

The former operated last year a total of 3,670 miles of road, the latter a total of 3,320 miles. With an alternating-current, high-potential system, the electric equipment of the line would not cost more than $6,000 to $7,000 per mile, including second, third and fourth tracks and sidings, or a total of $25,690,000 for the Pennsylvania, and $23,240,000 for the New York Central. If we count ten per cent. for interest, sinking fund, etc., this would represent an annual charge of $2,569,000 in the one case and $2,324,000 in the other.

The operating expenses for these two roads during the last year were made up as follows:

	Pennsylvania.	N. Y. Central.
Fuel for locomotives (motive power)	$6,000,133.94	$4,635,877.09
Water for locomotives	335,286.00	295,582.77
Other supplies for locomotives	382,548.12	334,672.56
Wages of engin'rs, firemen and roundhouse-men	5,716,847.83	4,829,442.54
Wages of other trainmen	4,442,127.34	2,991,334.66
Wages of switchmen, flagmen and watchmen	3,900,427.49	2,511,552.06
Other expenses for conducting transportation	14,540,541.88	11,607,537.54
Repairs to locomotives	4,412,983.29	3,608,971.89
Repairs to other equipment	10,674,725.61	5,661,991.79
Repairs to roadbed	8,541,935.48	6,145,341.10
Repairs to structures	4,122,017.98	2,454,690.96
General expenses	1,858,319.09	1,786,494.17
Grand total	$64,927,894.05	$46,863,489.13

Mr. De Muralt then applies the figures found during the course of his investigation, which lead to the following reductions if electricity were adopted as motive power:

Fuel, 10 per cent., or	$600,013.39	$463,587.71
Water, saved entirely	335,286.00	295,582.77
Other supplies, 50 per cent.	191,274.06	167,336.28
Wages to engineers, etc., 25 per cent.	1,429,211.96	1,207,360.63
Repairs to locomotives, 50 per cent.	2,206,491.65	1,804,485.95
Total amount saved	$4,762,277.06	$3,938,353.34

In the case of either road, the amount saved would be almost double the amount necessary to pay a handsome return on the additional investment, and Mr. De Muralt considers that he has been extremely conservative in eve y part of the estimate.

A conclusion is that it is not in the cost of fuel alone that we may

expect to find the economy of the electric system. Some of the other items taken together add up to a very important amount, and will cause the operating expenses of most roads to be smaller by using electricity than by using steam, without mentioning at all the advantages of increased comfort to passengers, and the possibility of greater speed should this be desired.

If water power can be used for producing electricity, that will simply mean an additional advantage. In that case, the cost of motive power will be greatly reduced, and the saving thus effected will amount to at least one-third of the total amount now spent for fuel, and often to a great deal more. For a railroad like the New York Central, capable of supplying practically its entire system from the water power of Niagara Falls, the upper Hudson and the St. Lawrence, this would represent an additional saving of more than one and a half million dollars yearly.

Of course, even with these convincing figures it would not do to imagine that a complete trunk line system of several thousand miles of road could be converted from steam to electric traction all at once. Yet there is no reason whatever why electricity should not be adopted immediately on those sections of the road where the saving is most apparent. Instead of spending each year large amounts for additional steam engines, as has to be done at present, these amounts could be used for gradually acquiring all the necessary electric locomotives; and, in the mean time, the steam locomotive thus rendered superfluous on the sections operated electrically could be used to complete the rolling stock of the sections still employing steam. The traffic could be carried on in exactly the same way whether steam or electricity was used as motive power, and thus the change could be made without interfering at all with the regular operation of the road.

The Use of Differentially Wound Telephone Receiver in Electrical Measurements.

By Prof. H. Ho, Tokyo.

It is known that a telephone receiver may rival in its sensitiveness the most sensitive mirror galvanometer, but its use in electrical measurements is limited by the fact that it is not adapted to replace a galvanometer in so-called deflector methods, though it has proved very useful in some of the nul methods, an example of which is the well-known Kohlrausch method of measuring electrolytic resistance. To remedy this inconvenience to some extent and to extend the use of the telephone receiver in electrical measurements, the writer has devised several methods involving the use of a differentially-wound telephone receiver, and believes he has found a new system of electrical measurements very useful in some cases, which will be briefly described below.

The receiver used was an ordinary double-pole pattern, the coils of which were replaced by differentially-wound bobbins, made by winding two similar wires side by side so that the two coils should be exactly equal in their magnetizing effect as well as in their resistance and inductance. The coils were each of 140 ohms resistance and proved perfect in their differential action.

I.—THE COMPARISON OF CAPACITIES.

The method of connection is shown in Fig. 1, in which C_1 and C_2

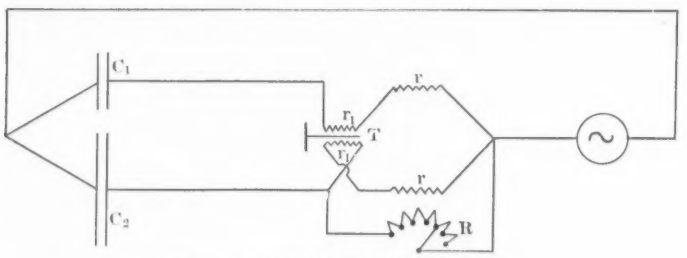


FIG. 1.—DIAGRAM OF CONNECTIONS.

are the capacities to be compared, C_2 being supposed larger than C_1; T is the differential receiver, r r two equal non-inductive resistances, R a variable non-inductive resistance which shunts a coil of the receiver and an r in series with the larger capacity; and finally, $\sim$ is the source of alternating current. The process of measurement is as simple as the connections. We merely adjust R until no sound is heard in the receiver, then if r is the resistance of each of the coils of the receiver, the required ratio of the capacities is given by

$$\frac{C_2}{C_1} = \frac{\dfrac{r_1 + r + R}{R\,(r_1 + r)}}{\dfrac{1}{r_1 + r}} = \frac{r_1 + r + R}{R}.$$

The inductance of a telephone receiver is usually very small compared with its resistance, but for security we have added in series, r having a value of 1,000 ohms, and in consequence the division of current in the two parallel paths, $r_1 + r$ and R, can be computed without taking account of the inductance; the derivation of the preceding formula is evident without further explanation. It is convenient to use a resistance box with sliding contact for R, and we may choose such a value of r as suits the case, and the value of R at hand.

This method is particularly valuable for the measurement of small capacities, it being necessary only to raise the alternating e.m.f.

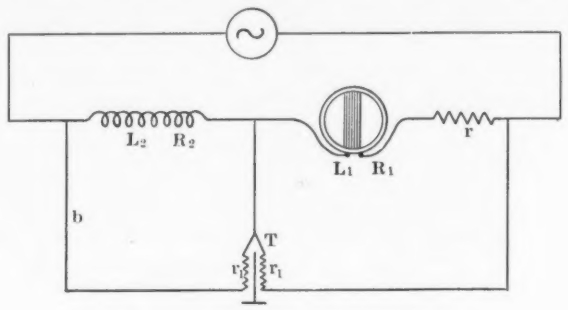


FIG. 2.—COMPARISON OF INDUCTANCES.

sufficiently to make the charging current audible in the receiver; moreover, it enables one to measure a capacity in an alternating-current circuit under its working pressure and frequency; for example, in the testing of cables. The method is thus quite simple and practical, and it may also prove useful in the study of the behavior of dielectrics under various pressures and frequencies.

To give an idea how accurate are the results which can be obtained by this method, even for very small capacities, we give here the results of the measurement of the capacities of three Leyden jars, designated A, B and C. The standard of comparison was a parallel plate air condenser, the capacity of which could be easily calculated from its dimensions and was found to be .00054 m.f.

C_1	C_2	r_1	r	R	The value of C_2 calculated.
Air condenser	A	140	1000	1145	.0010800 m. f.
Air condenser	B	140	1000	945	.0011934 m. f.
Air condenser	C	140	1000	1320	.0010044 m. f.

To test the accuracy, various groupings of the jars in multiple were tried, and the results were as follows:

C_1	C_2	r_1	r	R	The value of C_2 calculated.
Air condenser	A+B	140	1000	353	.0022788 m. f.
Air condenser	B+C	140	1000	365	.0022248 m. f.
Air condenser	A+B+C	140	1000	225	.0032778 m. f.

If calculated from the results in the first table, the numbers in the last column would be .0022734, .0021978 and .0032778 respectively.

Finally, comparisons between the Leyden jars themselves were tried and the following ratios were obtained:

C_1	C_2	r_1	r	R	The ratio $\frac{C_2}{C_1}$ calculated.
A	B	140	1000	10000	1.11
C	B	140	1000	5800	1.20
C	A	140	1000	15400	1.07

If calculated from the results in the first table, the ratios in the last column would be 1.11, 1.19 and 1.08, respectively.

From these measurements we may infer that even for such small capacities it is easy to get values correct within 1 per cent. The e.m.f employed was frnm 300 to 500 volts effective.

II.—THE COMPARISON OF INDUCTANCES.

In Fig. 2, L_2 is an unknown inductance, R_2 ohms in resistance, L_1 variable inductance, R_1 ohms in resistance; for example, Ayrton and Perry's standard of inductance, and T the differential telephone receiver.

A non-inductive resistance, r, is added either to L_1 or to L_2 to make them equal in resistance, and then L_1 is varied till no sound is heard in the receiver. In this condition, we have evidently $L_2 = L_1$.

If L_2 lies beyond the range of L_1, we may proceed as follows: Put in such a value of r that the resistance of the L_2 side is n times that of the L_1 side, and at the same time insert a non-inductive resistance, R, somewhere at b so that $R + r_1$ is n times larger than r_1. Now adjust L_1 till no sound is heard. In this condition we have evidently $L_2 = nL_1$. Choosing n properly we can bring L_2 into the range of an adjustable inductance at hand.

The method gives in ordinary cases the value of inductance correct within one per cent., and as may be seen, it is quite simple and direct. We are sure that any one who tries it for the first time will be surprised to find the quickness and the accuracy of the method.

III.—THE COMPARISON OF RESISTANCES.

In case the resistances to be compared are large, we adopt the same connection as Fig. 1, putting the resistances in place of the capacities. The method of the measurement is evident without description. If the resistances, R_1 and R_2, be very high, we may simply write

$$\frac{R_1}{R_2} = \frac{r_1 + r + R}{R}$$

If the resistances are low, they are to be joined in series and the

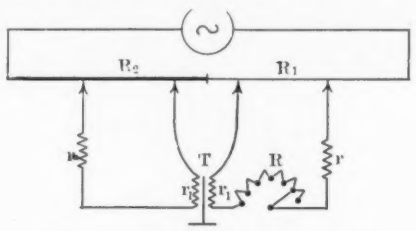


FIG. 3.—DIAGRAM OF CONNECTIONS.

receiver connected as shown in Fig. 3, the balance is then obtained either by moving the knife-edges or by varying the resistances of one of the receiver circuits, or applying both at the same time. The required ratio is given by

$$\frac{R_1}{R_2} = \frac{r_1 + r + R}{r_1 + r}$$

Independent Telephone Traffic Company of Cleveland.

The Independent Telephone Traffic Company, of Cleveland, which has succeeded the Ohio Independent Telephone Association, held its annual meeting at Hotel Chittenden, Columbus, May 12, 13 and 14. This company was chartered as an organization for mutual benefit for the independent telephone companies of Ohio. About fifty companies were represented at the meeting, the majority of them having previously become stockholders in the new traffic company.

The first day's session was devoted to regular order of business, including the report of President W. Gilbert Thompson, A. V. Hageman, treasurer, and H. H. Robinson, chairman of executive committee. After the session the members were given an opportunity to inspect displays of equupment furnished to the traffic company for that purpose by manufacturers. These exhibits were entirely in charge of officers of the traffic company, and there were no manufacturers' representatives present.

The papers presented were brief and to the point and they were freely discussed. They were as follows: "Reduction of Expense in Exchange Operation," F. L. V. Turner, general manager Cuyahoga Telephone Company, Cleveland, Ohio; "The Farmer Line Problem," O. F. French, assistant general manager Federal Telephone Company, Cleveland, Ohio; "Development of the Small Exchange," Howard Schwartz, general manager Star Telephone Company, Ashland, Ohio; "How to Make County Toll Line System Profitable," M. M. Herron, general manager Millersburg, Wooster & Orville Telephone Company, Millersburg, Ohio; "Economy in Long-Distance Operation," H. H. Robinson, general manager United States Telephone Company, Cleveland, Ohio; "The Value of Standardizing," H. C. Devin, general manager Mt. Vernon Telephone Company, Mt. Vernon, Ohio.

One of the chief aims of the traffic company is the standardization of telephone equipment of all kinds and members were asked to give freely their experiences with the products of various manufacturers. The sales department of the Independent Telephone Traffic Company is in the hands of Walter Green, general manager, Cleveland, and already large purchases of standardized equipment are being made through the department, the stockholders of the company reaping the advantages of buying goods in quantity.

The following directors were elected for the ensuing year: W. G. Thompson, Lebanon; Jerome Penn, Washington C. H.; W. J. Crawfley, Salem; Eugene E. Knox, Portsmouth; H. H. Robinson, Cleveland; C. E. Yoder, Bellefontaine; J. G. Palmer, Conneaut; A. V. Hageman, Lorain, and A. H. Doudna, Bridgeport.

A New Telephone Exchange for Yonkers, N. Y.

A new telephone exchange was occupied at Yonkers last month by the New York Telephone Company. The new four-story building erected by the company is situated on a lot 50 ft. x 100 ft. on the west side of Riverdale Avenue, about 150 ft. south of Main Street, and one block from Getty Square, the business center of Yonkers. The building is of fire-proof construction throughout, and is specially designed for telephone purposes. The four floors of this building are arranged and used as follows: The top, or fourth, floor will be used exclusively by the operating force of the central office. It is divided into two parts, one reserved for the operating room, and the other for the operators' quarters, and in order to allow the greatest possible amount of light and air is designed with a high ceiling and with windows in the front, rear and one side, and a skylight in the central portion of the ceiling. The operating room is 20 ft. wide and runs the entire depth of the building.

Next to the operating room is the operators' sitting room, to which the operators may retire when not on duty at the switchboard. This is a room 17 ft. x 16 ft., with two large windows in the front of the building. It will be furnished with easy chairs, etc., and newspapers and current magazines will be kept on file for the use of the operators. Next to the sitting room is located the dining room. This room is 11 ft. x 22 ft., and will be furnished with dining tables and chairs. An electric stove will be provided in this room, and coffee, tea and milk will be served to the operators free of charge during the lunch periods. Opening into the dining room and sitting room with a door leading directly to the stairs is a locker room. In this room lockers will be provided in which the operators will leave their hats, coats and lunches while on duty at the switchboard, and where they will leave their individual transmitter and receiver sets when they go home. A large toilet room for operators opens from the locker room.

The floors of all the rooms on this floor except the toilet room will be covered with linoleum. The toilet room floor will be finished with white tiling.

On the third floor of the building and directly under the operating room is situated the terminal room equipment. There are two other rooms on this floor 22 ft. x 30 ft. and 18 ft. x 22 ft. respectively, which are suitable for use as offices.

In the rooms on the second floor will be located a representative of the treasurer's office and the headquarters of the contract department for the Westchester division. There are, besides the rooms occupied by these offices, two other rooms suitable for offices, and a large toilet room for the use of the tenants. The ground floor will be divided into two stores.

Ultimate capacity of switchboard	4200 lines
Ultimate No. of "A" positions	20
Ultimate No. of "B" positions	3
Ultimate No. of common trunk positions	3
Ultimate No. of operators to be employed	50
Present equipment	3100 lines
Present No. of "A" positions	13
Present No. of "B" positions	1
Present No. of common trunk positions	1
Number of working lines at time of opening office	1200
Number of working stations at time of opening office	2100
Number of operators employed at time of opening office	30

The above statistics may be given as to the central energy switchboard and subscriber line equipment at the time of the opening of this office.

Annual Convention of Railway Telegraph Superintendents.

The twenty-second annual convention of the Association of Railway Telegraph Superintendents was held at the St. Charles Hotel, New Orleans, on May 13, 14 and 15. The convention was called to order on the morning of May 13 by President J. H. Jacoby, who made a few felicitous remarks. The welcome of the city was extended to the members by Assistant City Attorney McGuirk on behalf of Mayor Capdevielle. Mr. McGuirk extended the hospitality of the City Hall and all its electrical departments to any of the visitors who might wish to look it over. The address was appropriately responded to by President Jacoby.

It was voted to hold the next annual meeting at Indianapolis, Ind., on the third Wednesday in June, 1904, on account of the proximity of Indianapolis to St. Louis, thus affording the members an opportunity to visit the big exposition.

The election of officers for the ensuing year resulted as follows: President, C. S. Rhoads, of Indianapolis; vice-president, C. P. Adams, of Chicago; secretary-treasurer, P. W. Drew, of Milwaukee. After the election of officers, Mr. C. E. Yetman, of New York, explained the operation of his new typewriter transmitter, which is now being used on the telegraph circuits of the Associated Press and other news-distributing concerns. The instrument attracted much attention and was critically examined by the members.

An amendment to the constitution was unanimously agreed to relative to qualification for membership. Under the new limitations, membership can be greatly extended and associate members may now be admitted. The latter can engage in the proceedings of the meetings but are not entitled to vote.

Secretary Drew gave a little history of the work of the association up to the present time, and closed with a touching tribute to those who had fallen in the line of duty. His review was followed by the election of several new members and of associate members. Letters of regret at their inability to be present were read from Assistant General Manager J. C. Barclay and General Superintendent B. Brooks, of the Western Union Telegraph Company; T. D. Lockwood, of Boston, and several others.

In the afternoon the American Telephone & Telegraph Company tendered an excursion to West End, where the party was given a delightful luncheon. This affair was managed by the company's special agent, Mr. Percival W. Miller. At the conclusion of the luncheon, remarks were made by several gentlemen. Col. William H. Adkins, traffic agent of the Southern Bell Telephone & Telegraph Company at Atlanta, acted as toastmaster, and various toasts were appropriately responded to.

The second day's session was called to order at 9.30 A. M. by the new president, C. S. Rhoads. The first order of business was a paper written by Wr. William Maver, Jr., and read by Mr. Jacoby, entitled, "Railway Safety Block Signals," which presented some new ideas on the general subject. The paper was discussed at considerable length by many of the members.

This was followed by the reading by the secretary of some notes, also by Mr. William Maver, Jr., on the subject of Multiplex Telegraphy.

The author stated that it was long ago shown to be feasible to operate a polar duplex on circuits on which there was the equivalent of a number of 150-ohm relays. These experiments were described in the ELECTRICAL WORLD October 6, 1888. He congratulated Mr. Fry, of Milwaukee, on his practical success in work in this line and if he (Fry) succeeded in operating the Edison quadruplex on a similar wire he was deserving of especial congratulation. Mr. Maver had never succeeded in making the No. 2 side work in the manner required in commercial practice on account of the inductance of the relays. Of course if one should by a fortuitous combination of circumstances, or by design, obtain capacity and induction in the right proportion on the line, as pointed out by Dr. Pupin, he would doubtless get successful results on the quadruplex even with a number of relays in the line.

Mr. C. F. Annett, of Chicago, read several letters written by men in charge of wrecking trains on the Illinois Central Railroad, speaking in the highest terms of the utility of the telephone as part of the wrecking train equipment and the superiority of the long-distance telephone over the telegraph in such work.

Mr. W. W. Ryder, of Chicago, next read a paper in which he described his new switchboard, which he had found so simple to understand and operate that the average railroad telegraph operator could manipulate it without previous instruction. This paper led to the suggestion of action on the part of the association looking to the instruction of operators in the practical use of switchboards, and the subject was very freely discussed.

After adjournement at 1 P. M., the members of the association spent a couple of hours in riding around the Illinois Central belt, taking in the various points of interest along the road, and in the evening the entire delegation attended the opera at the Athletic Club Park, where *"Fra Diavolo"* was played.

At the third day's session, May 15, the committee on courtesies submitted its report, thanking all who had contributed to the pleasure of the members during their stay in the city and to the success of the meeting. Other business transacted at this meeting was the description by Mr. G. L. Lang, of the automatic telegraph circuit and signaling machine of Mr. C. K. Jones, and the reading of a paper by Mr. F. A. C. Ferguson on "The Composite Telegraph and Telephone Circuit." The latter subject was discussed and a committee was appointed to investigate the working of circuits now in operation, in order to pass upon the efficiency of the use of a single wire for telephone and telegraph communications at one and the same time. A representative of the Bell Telephone Company referred to an instance where he had received a telephone message with almost perfect precision while the wire was being operated for telegraph purposes between Pittsburg and New York. On the other hand, instances were pointed out where the transmission of telephone messages over underground circuits was interfered with by simultaneous transmission of Morse telegraph messages on the same wire. In the discussion, however, it appeared to be evident to those present that simultaneous transmission could be satisfactorily accomplished, and the members were favorably impressed by what they had learned as a result of the discussion of the paper. Other business transacted included a paper by Mr. F. F. Fowle on the "Transposition of Telephone Circuits," which he illustrated by blackboard diagrams, and a paper by Mr. W. W. Ryder on the "Telegraph Camp Train."

The convention then, at 1 P. M., adjourned to meet next year in Indianapolis.

During the business meeting of the last day, the ladies of the party were conducted through the old French quarters of the city and in the afternoon taken on a steamboat excursion around the harbor. On Saturday, May 16, the Louisville & Nashville Railroad Company gave an excursion to the delegates to several points on the Mexican Gulf.

Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

PRODUCTION OF ALKALI EARTH METAL PERMANGANATES.

Wilhelm Hickmann, of Frankfort-on-the-Main, Germany, assignor to the Chemische Fabrik Griesheim Electron, patents an interesting method for the production of the permanganates of the alkali earth metals, salts whose formation does not readily take place by simple double reaction with the easily-prepared alkali permanganates. In its simplest embodiment the process is carried out in an electrolytic cell provided with a diaphragm, the cathode compartment being filled with dilute potassium hydrate and the anode compartment with a solution of potassium permanganate, maintained saturated, and carrying calcium hydrate in suspension. On passage of the current permanganic acid is formed in the anode compartment, and combines directly with the calcium hydrate therein contained to produce the desired salt. According to a second method the cathode compartment contains a saturated solution of potassium chloride, and the anode compartment a solution of potassium permanganate in which a limited amount of calcium chloride is dissolved. The reaction proceeds in this case with liberation of chlorine and production of calcium permanganate in the anode compartment.

ELECTROLYTIC REDUCTION OF METALS.

The cathodic reduction of metallic compounds has developed along two quite independent lines, both of which have led to substantially similar results in the apparatus employed and in the method of procedure. On the one hand the metallic compound, as the oxide or sulphide of such readily reducible metals as copper or lead, may be considered as a depolarizer when the object in view is to avoid the presence of hydrogen or to reduce the e.m.f. required for a given

reaction; and on the other hand, when the object is to produce a metallic sponge, the metallic compound is regarded as an ore to be reduced, hydrogen as a convenient reducing agent, and the electric current as a means suitable for the production of hydrogen. In either case, of course, the process and result are identical.

Richardson, in 1893, made this cathodic reduction of metal compounds continuous by the expedient of evenly spreading over the surface of a moving cathode belt a layer of the compound (copper oxide) to be reduced and carrying the same slowly under stationary anodes, the metal being removed from one end of the cell and fresh oxide supplied to the other. Richardson's purpose was to reduce the e.m.f. in the electrolysis of brine.

Mr. Pedro G. Salom now patents an apparatus similar in its mode of operation to that of Richardson but differing in form in that for a moving belt serving to carry the compound to be reduced he substitutes a rotary annular trough (cathode); or, since the essential point is a relative movement, the trough may be stationary and the anode may slowly revolve above it. As applied to the reduction of galena the apparatus consists of an annular lead-lined cathode trough containing the ore to be reduced in the form of a thin layer and the sulphuric acid electrolyte. The anode is also of lead, and conforms in a general way to the shape of the trough into which it depends, a segment being cut away, however, to provide for the introduction of the sulphide and the removal of the lead. The anode is arranged to swing slowly around in the trough, whereby portions of the latter are uncovered in succession, the fresh ore being introduced at the advancing side of the anode and the reduced lead removed as it is uncovered by the retreating side. A hopper and distributing plate serve for the automatic introduction of the charge, the withdrawal of the sponge being conveniently accomplished by hand.

As a curious instance of the development of very similar devices for widely differing purposes it is interesting to note in this connection the carbide furnace patented in Germany to Hermann Nicolai. This furnace consists of a horizontal rotary annular trough constituting an electrode, the charge being introduced into the same at one point by a hopper and the finished product removed by a scraper at another point. Intermediate to these two points are devices for distributing and compacting the charge, and the hooded electrodes by which the conversion is effected. Except for the concentration of current incident to the carbide process, the apparatus of Nicolai corresponds closely with that of Salom.

New Telephone Patents.

A new insulator patented to J. B. Bell, of Peakville, Pa., is of that type in which tie wires are ordinarily dispensed with. The main insulator is of the usual petticoated type with the ordinary tie wire groove, but the top instead of being rounded, is drawn out into a threaded boss. This boss is divided through its center by a longitudinal tapered slot from the sides of which project staggered frets in a manner such that a wire forced into the slot will be given a horizontal kink. This insulator body is surmounted by an insulating cap arranged to screw down over the boss and so provided with a downwardly extending lip that when screwed home, a vertical kink is given to the wire. By these means a wire may be secured against slipping through the insulator.

An inductance coil cable is the invention of Francis Tremain, of Highgate, England. It is his object to provide a construction for submarine cables whereby there may be included within it at intervals inductances of such magnitude that the advantages of the Pupin method of transmission may be obtained for submarine work. The problem involves a coil of considerable length, yet semi-flexible, so that it will not be damaged in the handling of the cable. Fig. 1 shows a coil section of the cable core, two varieties being exhibited. At the center is a core of fine metallic wires, magnetic or not, according to the magnitude of the inductance desired. Surrounding this is an insulating tube upon which the coil is mounted in one or more parts. Each part of a coil consists of a series of short sections wound indefinitely. These are about three-sixteenths inch long, and being impregnated with an insulating binding material form practically independent annular rings. It is this construction which gives the flexibility to the structure. Between each two coils an insulating spacer is placed which serves as a guide for such conductors of the cable as do not tap the particular coil in question.

Lead-covered aerial cable, the present day standard, at times fails due to imperfections or cracks in the sheath, which are not discovered or do not occur until the cable is in place. Such openings admit moisture to the cable, which, being absorbed by the paper effectively short-circuits the whole in a remarkably short space of time. To repair the defect it is customary to "boil out" the cable by treating the exposed core with hot paraffine wax. Such a procedure is at times very awkward, especially if the break is between poles. To facilitate such repairs, Mr. John Daggett, of Elyria, Ohio, has devised his repair apparatus. This consists of a trough-shaped receptacle mounted on trolleys so that it may be suspended from and moved along a messenger wire. Beneath the middle of the trough a torch is carried and within it the paraffine is melted and allowed to act upon the cable, let down into it from the messenger for that purpose.

A patent for a subscriber's station annunciator has been granted to George K. Jackson, of Reece, Kan. The device consists of a short strip of sheet metal swiveled near its center upon a nut or a bushing adapted to be placed upon one of the gong supporting studs of a magneto bell. This metal strip is so mounted that it is nearly balanced about its axis and one end is so shaped that it may engage the bell hammer. To set the annunciator the strip is placed horizontally and the hammer is so made to engage it that it will remain in this position. When a call is received the vibration of the hammer releases the strip, which, by its unbalanced weight, will swing into a vertical position, thereby indicating a call. Such a device is most useful where a large number of telephones are so placed that the rings do not readily indicate at which instrument a call is to be

FIG. 1.—TREMAIN CABLE.

answered. Two receiver patents refer primarily to methods of holding the diaphragm. Both inventors, Messrs. M. R. Hutchison and W. L. Denio, respectively desire to provide a mounting by which not only is an elastic contact between the casing and diaphragm maintained, but by which an initial buckling stress is put upon the diaphragm. Such a stress renders a diaphragm more sensitive than normal. Mr. Hutchison accomplishes his result by encircling the diaphragm with an elastic rubber band, which clamps it tightly. This reduces the resistance to the slight motion of the periphery of the diaphragm accompanying its vibration, and at the same time it causes the desirable initial buckling stress. Mr. Hutchison also surrounds the rubber clamping band at intervals with a metallic strip which will serve to connect the diaphragm electrically with its case where this is desirable, as say where the diaphragm is used in a transmitter; and also serves to hold the rubber band in place. These metal strips are mounted by inserting one end beneath the edge of the band and then bending it about the outside of the band to a position parallel to but upon the other side of the diaphragm from the starting point.

Mr. Denio holds his diaphragm in place by means of metallic spring washers. Several shapes are suggested, either one or two washers being provided for a single diaphragm. These washers may be plain concave, fluted concave, or may be scalloped on the inside, the points being turned up to bear upon the diaphragm to give the initial bias.

Two selective ringing patents, describe step by step selective apparatus, one relying on an electrical lock for the non-wanted stations, while the other provides a mechanical lock. Both have the very material disadvantage of a considerable complication of moving parts at the subscriber's station, just where it is a considerable trouble to get at and adjust it. Both devices are shown sufficiently well for explanation in Fig. 2. The electrically-locked device is that shown in the upper part of the figure. This is the invention of F. E. Green, of Newburyport, Mass. There are two sets of signalling contacts; the first, normally open and included directly in the bell circuit, is shown just above the left-hand magnet spools. This contact tends

to close, but is held open by the extremity of the toothed slider. Attached to this contact, in addition, is the equivalent of a dash-pot. The result of this is that even when the contact is released by the slider an appreciable time is required for the circuit to be closed. The second contact is normally closed and is shown to the right of the left-hand magnets, the movable member projecting up in the path of the swinging ratchet dog extending downward from the main slider. This contact forms a short-circuiting shunt on the bell, and it is the distance relation of the contact and dog which determines the selection of the station for signalling.

When any station is desired, the operator sends out to the line a

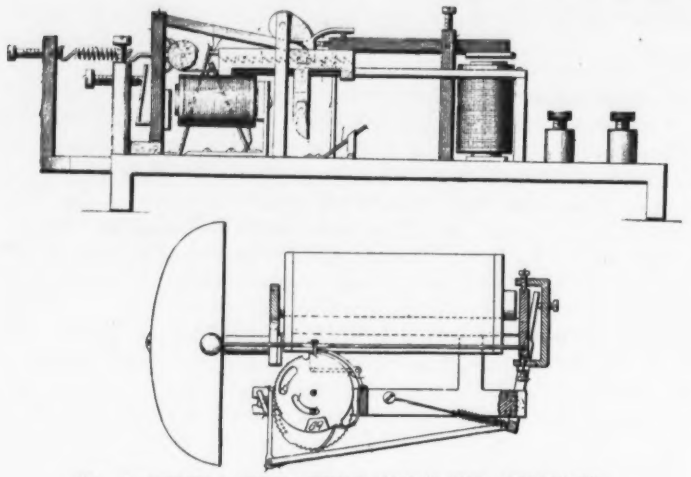


FIG. 2.—GREEN AND WATKINS SIGNALLING APPARATUS.

series of impulses, all being of brief duration save the last, which is maintained for the length of time it is desired that the bell at the wanted station shall ring. At the first short impulse, the operating or left-hand magnets at all stations, which are across the line circuit, actuate their armatures and advance all sliders one tooth. At all stations the main contacts are released and begin the retarded process of closing. At station A another action has taken place. The shunt contact has been opened by the ratchet dog. The bell does not ring, however, unless A is desired, for otherwise the first impulse will be short and the second quickly following it will step the dog over the shunt contact and allow it to close before the slow-acting main contact has closed. The long duration last impulse of a signal does, however, allow the main contacts to be made while the short-circuit contact at the desired station remains in engagement with the dog.

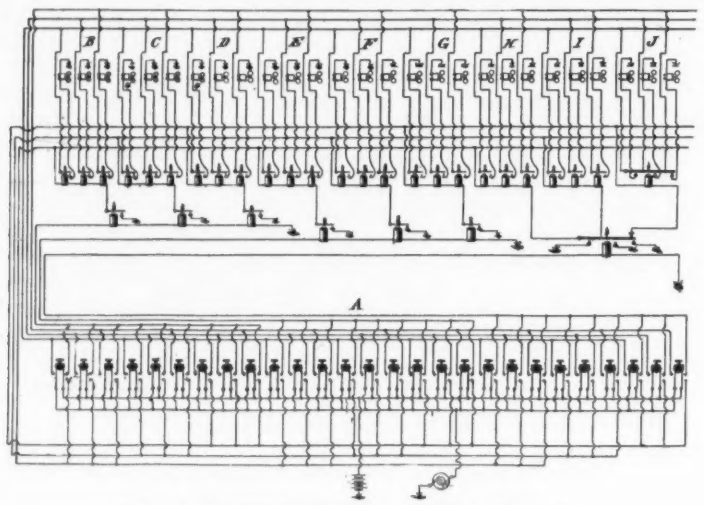


FIG. 3.—SMITH TELEPHONE CALLING SYSTEM.

The bell at this station, therefore, sounds receiving current from a local battery. Of course, the signal circuit at all other stations is at this time closed, but this is without effect on the bells at these stations, as they are all shunted by the second contacts. Now there is a second magnet shown at the right. This is a tripping magnet and is in the bell circuit, so that when the main circuit is closed this magnet is energized and thereby raises both actuating and retaining falls and thus the slider is returned to zero position by a retractile spring attached to it.

Referring now to the second selector shown in Fig. 2, it is seen that besides the regular vibrating armature of the ringer, a second armature with pivots at right angles to this is provided. This last armature is so mounted as to be unaffected by the polarizing magnet, and it is, therefore, similarly responsive to currents in either or both directions. This armature, through an arm and pawl, affects the rotation of two eccentrically mounted ratchet discs. Both discs tend to return to the unactuated position by gravity, each being provided with a counter weight. One, the upper, is allowed at all times to respond to this tendency. On the other hand, the second is held by a retaining pawl, except just at such times as the first disc has reached its normal position. In the figure a locking bolt is seen projecting across the bell hammer rod. This bolt is held in the interfering position by the two ratchet discs, which virtually serve as tumblers for the lock. Each disc has a notch in it and when these come into coincidence the bolt drops and releases the bell. On the upper or free disc the notch registers with the bolt when in the normal or returned position. On the lower disc the notch registers just when the number of teeth corresponding to the station number have passed the ratchet fall.

As with the preceding apparatus, the operator sends out a code signal, the first impulses being of short and the last of long duration. Each impulse serves to turn both discs, the upper getting an unrestrained throw of a considerable angle and the lower moving one tooth and being then stopped and held by the retaining fall. If the second impulse follows quickly no lock is released, as at no station does the upper disc get back to normal position before reactuated by the following impulse. If one is the code number of the station desired, then the first impulse will also be the last, and being maintained for some considerable period, the free disc will have time to return to zero. By construction the notch of the first station will be beneath the bolt. Therefore, the bolt at this station will be released and the bell will ring. At the same time at all other stations the free disc will have returned to rest and thereby deflect the retaining falls of the respective lower discs. These latter are then free to return to zero as soon as the cessation of the ringing current, following the release of the operator's key at central, allows the actuating pawls to pass back upon the free discs in the upward motion. Mr. W. D. Watkins is the inventor of this system of selection.

Three other selective system patents all cover modifications of the same general scheme, namely that of employing a sufficient number of wires to effect a considerable number of different combinations. For example, with the circuits shown in Fig. 3, using nine wires from central, 27 stations may be selectively signalled. And if polarized relays be used it is possible to greatly increase the number of combinations and one hundred and eight stations may be selectively signalled over these same nine wires. This use of polarized relays is the subject of a second of the patents, while the third omits the tertiary relay circuits, bringing the number of circuits to six and the number of stations to nine. These patents have been granted to Charles B. Smith, of New York City.

Mr. Smith has also obtained a patent for an automatic telephone system. In this system there is no central office, but the automatic devices are scattered at the various sub-station premises. As with his selective systems, Mr. Smith requires a considerable number of wires all reaching every station. This, of course, prohibits an economical line construction. In fact, it would seem a prohibitive feature. It is impossible to describe the apparatus in detail here, but some idea of its complication may be obtained from Fig. 4. Three selective and signalling wires and one battery wire loop into each station, and several pairs of talking wires tap into each station. The talking wires are the equivalent of the connecting cords of manual systems and an equivalent number are required. The scheme of operation is as follows: Of the signalling wires, one is continuous from station to station, while the other two are in short sections, extending from one station to the next only. One of these sectional wires normally broken up, is adapted to be made up into a continuous line, the making-up process proceeding about the circuit of stations in definite, say left-handed, direction, in response to the automatic apparatus. The second sectional line, normally continuous, is simultaneously broken up. The general process of making a connection involves the automatic sending of impulses through the respective stations to the left, to the desired station, the apparatus at each intermediate assisting in forwarding the connection to that next to the left. When the desired station is reached a signal is sent out to it over the normally closed sectional wire. After the signal is received automatically, upon the cessation of the current all selective wires are broken up or reformed to normal condition, as

the case may be. The removal of the receiver from the hook serves to pick out automatically the lowest numbered idle talking wires and simultaneously to cause the called station to select the same pair. Of the apparatus shown in the figure, the lowest is the signal forwarding apparatus and next above is the selective and signal transmitting apparatus, while at the top is the talking circuit selective apparatus.

The final patent granted last week is one for a "Combined Telephone and Fire Alarm System." This system is for use with central energy lamp-signal switchboards, and is the work of W. L. Denio.

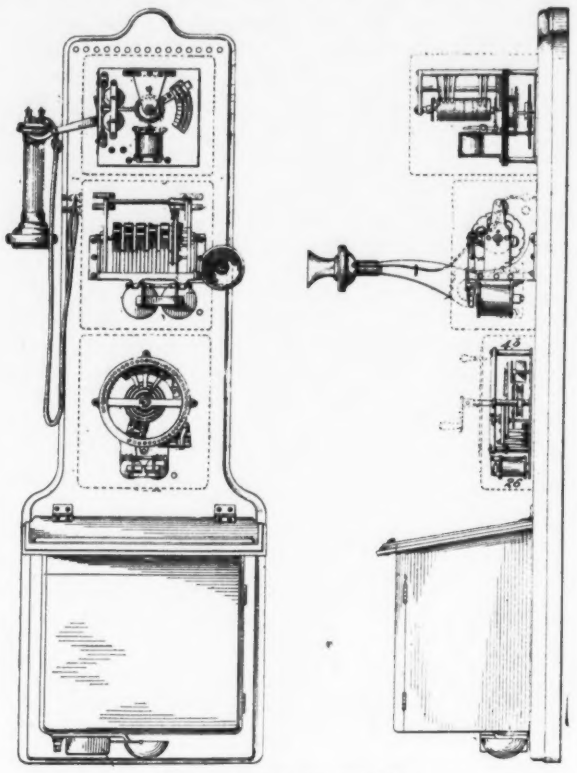


FIG. 4.—SMITH TELEPHONE.

The fire alarm apparatus is controlled by thermostats distributed about the subscriber's premises. It sends a code flash signal to the central office, which signal appears at the line lamp, giving the station number. That this may be distinguished at once as a fire signal, the circuit is carried through a vibrator, which causes a fluttering lamp flash and at the same time rings the subscriber's bell. A burglar alarm attachment sends the code signal, but omits the fluttering feature and the subscriber's bell signal. The apparent utility of this device is much greater than the real, as in a busy exchange in the day the operator would very probably miss the signal, at least in part, while at night it is more than probable that no operator would see the whole signal in large systems, while in small ones the operator would probably not be present at the switchboard at all when the signal began.

Niagara Meeting of the Electrical Engineers.

Prof. G. F. Sever, chairman of the general committee for the meeting of the American Institute of Electrical Engineers at Niagara Falls, on Monday, July 3, sends us the following programme:

Monday—Institute and President's Day (Morning) 9.30 to 1.—President's Address. Lunch, 1.00 to 2.00. Afternoon—Visits to local points of interest. No pre-arranged programme. Evening—No pre-arranged programme.

Tuesday—Electrical Day (Morning) 9.30 to 1.—Railroad Papers. Lunch, 1.00 to 2.00. Afternoon (2.15).—Tour of inspection of electrochemical and other electrical installations operated by the Niagara Falls power and power houses of the Niagara Falls Power Company. Evening—Dance under the auspices of local committee at Cataract House.

Wednesday—Niagara Day (Morning) 9.30 to 1.00.—Power Transmission Papers. Lunch, 1.00 to 2.00. Afternoon—Trolley trips to Niagara Gorge, Fort Niagara, Brock's Monument, Chippewa. Visits to following plants: Niagara Falls Hydraulic Power & Manufacturing Company, Canadian Niagara Power Company, Natural Food Company. Evening—Entertainment Cataract House, under auspices local committee and general committee.

Thursday—Excursion Day (Morning) 9.30 to 1.00.—Miscellaneous Papers. Lunch, 1.00 to 2.00. Afternoon—Excursions to Olcott Beach, St. Catharines, Lockport, Tonawanda Sub-Station. Evening—Illumination of Gorge route.

Friday—Buffalo Day (Morning) 9.30 to 1.00.—Joint meeting with Society for Promotion of Engineering Education. Adjournment of technical meetings. Lunch, 1.00 to 2.00. Afternoon—Trips to Buffalo, Buffalo General Electric Company, Buffalo Terminal House. Adjournment of Institute convention.

Following is a partial list of papers promised: "The Energy Transformations in the Synchronous Converter," by W. S. Franklin; "The Storage Battery in Sub-Stations," by W. E. Goldsborough and P. E. Fansler; "Commercial Alternator Design," by W. L. Waters; "The International Electrical Congress of 1904," by Elihu Thomson; "Symbols and Nomenclature," by Carl Hering; "The Magnetic Units," by Dr. A. E. Kennelly; "The Legalized Standard of Electromotive Force," by Prof. H. S. Carhart; "Institute Branch Meetings, their Organization, Development and Influence," by Calvin W. Rice.

Programme of the Chicago N. E. L. A. Convention.

Below will be found the programme of papers and reports for the Chicago twenty-sixth annual convention of the National Electric Light Association, day by day. The meetings will be held at the Auditorium Hotel, which will be headquarters:

Tuesday Morning, May 26.—Address of President Ferguson. Report of editor of *Progress*, Mr. T. Commerford Martin. Report on office methods and accounting, W. M. Anthony. Tuesday Afternoon.—Paper on advantages derived from use of one system of generation and transmission of electrical energy from all power stations in one locality, Mr. Charles L. Edgar. Paper on standard ratios for transformers, Mr. John S. Peck. Paper on boiler and furnace efficiencies, Mr. A. Bement. Report of Committee on Flue Gases, Henry L. Doherty, chairman.

Wednesday Morning, May 27.—Paper by Charles F. Scott on the young engineer and the electric lighting plant. Paper on tactful relations with customers, Mr. John W. Ferguson. Paper on attitude of employer toward benevolent, insurance and educational associations among employees, Mr. Arthur Williams. Paper on first aid appliances, Dr. J. D. McGowan. Wednesday Afternoon.—Paper by Prof. Elihu Thomson. Paper on steam turbines, Prof. Wm. Lispenard Robb. Paper on district heating, Mr. John W. Glidden. Paper on the application of four-ampere series alternating arc lamps for street lighting, Mr. Henry Hallberg.

Thursday Morning.—Paper on salt as a by-product, Mr. Alex Dow. Paper on some fundamentals of photometry, Prof. H. E. Clifford. Report of Committee on Photometric Values of Arc Lamps, Mr. Henry L. Doherty, chairman. Exhibition and description of the Matthews integrating photometer, Prof. Charles P. Matthews. Report on decorative and sign lighting, Mr. Arthur Williams. Thursday Afternoon.—Paper on relative advantages of electrical and mechanical methods of variable speed control for general power service, Mr. William Cooper. Report of theft of current, Mr. Robert L. Elliott. Report, unaccounted, for current, Mr. L. G. Van Ness. Report of Committee on Standard Electrical Rules, Captain William Brophy, chairman. Question box. Executive session. Reports of secretary and treasurer and Executive Committee. Election of officers.

As already noted, Mr. James Wolff has been appointed by President Ferguson as chairman of the local reception and entertainment committee for the convention of the National Electric Light Association. This committee has arranged to have a general reception in the Auditorium parlors on Monday evening, May 25, from 8.30 to 10.30. Arrangements are also being made for a tally-ho party on Tuesday morning for the ladies attending the convention, to drive to the Washington Club, where they will have luncheon. After luncheon they will drive through the South Parks, returning to the hotel in the afternoon. A matinée party at one of the theatres is contemplated for the ladies on Wednesday afternoon. Engrossed invitations were issued last week for the Monday reception.

CURRENT NEWS AND NOTES.

TELEPHONE CONVENTION.—The annual convention of the National Independent Telephone Association will be held in Chicago June 24 and 25. The secretary is Mr. J. B. Ware, Ellicott Square Building, Buffalo.

WIRELESS TELEGRAPHY IN ALASKA.—Secretary Root has, according to a Washington dispatch, approved plans for the erection of a wireless telegraph system between Cape Nome and St. Michael, in Alaska. Masts 200 ft. high will be erected at both places.

COMMERCIAL AUTOMOBILES are to be given a test this week by the Automobile Club of America in New York City, under rules and regulations already announced. Six classes are made, divided along the line of dead load capacity. The electrical entries at present are inconsiderable."

MUNICIPAL ELECTRICIANS.—The Executive Committee of the International Association of Municipal Electricians has fixed September 2, 3 and 4 for the annual convention, and selected the Hotel Rudolf, Atlantic City, N. J., as the headquarters. An exhibition of wireless telegraphy will be one of the special features of the convention.

ROWLAND SYSTEM IN ITALY.—A special cable message from Rome of May 16 says: "The American engineers, Wiegand and Penniman, have arrived here for the purpose of making certain telegraphic tests. They will apply Rowland's apparatus for the simultaneous transmission of eight dispatches over one wire on the Italian telegraph lines."

TELEGRAMS IN MANCHURIA.—A British official at Shanghai has received from the Imperial Chinese Telegraphs a memorandum which, verbatim, is as follows: "In regarding to charges to New-Chwang at old time is 38 cents per word, but since Russian has occupied at Manchu, charges being increased to dollar ten cents, as they treat Manchuria same as Russia in Asia." This official intimation is considered significant.

THE LIEBIG CENTENNIAL.—The Verein Deutscher Chemiker celebrated the hundredth birthday of Justus von Liebig with a dinner at the Chemists' Club, 108 West Fifty-fifth Street, New York, on the evening of May 12. The speakers told of incidents in the career of the German master chemist. Among those who spoke were Prof. Ira Remsen, president of Johns Hopkins University, and Prof. William H. Brewer, of Yale. About 300 were present.

LIGHTING NOTRE DAME, PARIS.—The Paris correspondent of the *New York Herald* writes: "An American sightseeing in Paris told me he had been in Notre Dame and seen the Cathedral in the evening, lighted by electricity. He was much disappointed. The hard, brilliant searching light banishes the dim religious shadow which gives a charm and mystery to the venerable church. Modern improvements do not harmonize with mediæval mellowness."

MARCONI RESTING.—Mr. Marconi has, according to a recent dispatch from Rome, suffered a relapse from an attack of influenza, owing to overexertion, and has gone to Bologna for a fortnight's rest. Before leaving he is said to have completed negotiations for the establishment on the coast of Tuscany of an extra powerful wireless telegraph station to connect with the Argentine Republic. The government, the dispatch adds, will contribute $140,000 toward the project.

DRAWBAUGH WIRELESS TELEPHONE.—A dispatch from Harrisburg, Pa., states that Daniel Drawbaugh, the well-known inventor, who resides near that city, is completing a wireless telephone system. He is now able to converse over a distance of one mile, so the dispatch states, and when he completes a new apparatus, upon which he is now at work, he expects to be able to talk five miles. It is stated that Dr. Ward, of the University of Pennsylvania, who represents the United States Signal Corps, is closely watching Mr. Drawbaugh's experiments.

AERONAUT MONUMENT IN PARIS.—A novel and ingenious monument by Bartholdi to the aeronauts of the Siege of Paris is to be erected in the vicinity of Montmartre. It will stand about 60 ft. high, and be capped by a balloon of bronze, glass and transparent mica. Its diameter will be about 10 ft., and inside will be an electric lamp with a reflector, so that by night the monument and the sursounding place will be illuminated. The balloon will be guided by a symbolical figure of the Genius of Paris, and under it a mother with her dying children will represent the City of Paris.

A WIRELESS TELEGRAPH POOL.—A cable dispatch from Berlin of May 16 says: "It is understood that the agreement between the Allegemeine Eliktrizäts Gesellschaft and the Siemens-Halske Company regarding wireless telegraphy will take the form of a trust, of which the component parts will be the Slaby-Arco system of the former company and the Braun system of the Siemens-Halske combination. This combine will then make a working arrangement with Marconi's company. The capital of the new trust will probably be a million marks. It is believed that Count Arco will be the director."

TRIAL OF SUBMARINES.—The electric submarine torpedo boat *Porpoise,* in a government trial on May 18 on Peconic Bay, off New Suffolk, fired a torpedo at the end of a successful submerged run of a mile and a half. The missile went straight between two flags set 150 ft. apart, representing a war vessel. The Navy Trial Board, represented by Capt. C. J. Train, Capt. Charles R. Roelker, Commander W. C. Cowles and Lieut. J. J. Woodward, were satisfied with the result. The submarine *Shark,* in three surface trials of a mile each made an average speed of 7.25 miles an hour, which exceeds the government requirements by a quarter of a mile.

OMNIBUSES IN PARIS.—A cable dispatch from Paris of May 9 says: "When is an omnibus not an omnibus?" This is a question on which millions of American money depend. Fifty years ago the omnibus company was intrusted with transportation from one point to another in Paris. Of late years lines of tramways from the suburbs, heavily financed from America, have been allowed to penetrate to the center of the city. The omnibus company declares this is a breach of its monopoly and sues for an interdict. The municipality denies that a tramway is an omnibus line and says there is no breach of contract. All the big counsel in Paris are engaged on the case.

LIGHTING FORT RILEY.—According to the *New York Sun,* the authority recently granted by the War Department for the lighting of the reservation at Fort Riley by electricity is of more than local importance. The geographical center of the United States lies within the limits of the post, and at present the conical roof of a large cistern situated on the highest ground of the reservation covers it. When the electrical plant is installed, it is proposed to place a lamp on the top of this roof, the light of which will be visible for miles in every direction. This will be a shining mark by night, while the hill and its lofty tank indicate clearly by day the middle point of our continental system.

LONG RANGE FOR CAMERAS.—With reference to an item of news in our last issue, the following special cable dispatch of May 16 from London will be of interest: "Henniker Heaton, M. P., England's leading postal reformer, has just returned from Rome, whither he accompanied his intimate friend, Marconi. He told the *World* correspondent to-day of the latest scientific wonder which he saw there—the taking of photographs at a distance of from twenty to twenty-five miles. 'I visited one of Marconi's radiograph stations, three miles outside of Rome, in the Campagna,' he said, 'and was shown there perfect photographs of a large size taken by electricians and scientists from that station of views in the mountains twenty-five miles away. How this marvel was accomplished is their secret. Whether it was done by some new ways of utilizing the Hertzian waves or an entirely new discovery, I am unable to say. The photographs were clear, bringing out in sharp definition the outline of houses and the figures of men and women as though taken only ten or twenty yards off. They appear able to extend or narrow the field at will. One of the operators told me that in a short time they hope to be able to take photographs of objects and places two hundred miles distant and enable you to see the person you are telegraphing to at that range. No one is permitted to enter the radiograph station, and, so far, the secret has been admirably kept.'"

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION.—The adjourned annual meeting of the New York State Independent Telephone Association will be held at the Butterfield House, Utica, N. Y., on June 10, 1903. Officers will be elected and other business transacted. Mr. Charles O. Harris, 59 Stone Street, Rochester, N. Y., is secretary of the association.

DISABLING TELEPHONE SERVICE.—A recent telegram from Chicago says: "Out of an apparently insignificant strike has grown a great deal of trouble for the telephone patrons of Chicago. The cable splicers are fighting the Chicago Telephone Company, and to-day their sympathizers cut the cables in one of the big trunk conduits of the West Exchange. As a result 700 telephones in the Northwest Side are useless. Non-union men were sent to splice the break, but their work was interfered with by strike sympathizers, who attacked them and threw stones at them."

MOST POWERFUL SEARCHLIGHT IN THE WORLD.—The *Woman's Magazine,* of St. Louis, has given the General Electric Company an order to build an electric searchlight, which shall excel in size and illuminating power any heretofore constructed. This searchlight will be placed on the dome of the new building, which the publishers of this magazine are erecting on University Heights, just out of the city limits, and in full view of the Exposition Grounds. This searchlight promises to be one of the most striking advertisements yet employed.

ELECTRIC AUTOCAR IN BELGIUM.—A report from the United States State Department says: "Consul-General Richard Guenther writes from Frankfort, April 7, 1903, that, according to the *Journal de Bruxelles,* the International Sleeping Car Company has given orders for building an electric autocar, which by August next will be running upon the Belgian State Railroad between Brussels and Ostend. The distance of 125 km (78⅛ miles) will be covered, it is stated, in less than an hour. The car will carry 40 passengers." What this items of news means is not quite clear.

ENGLISH ELECTRICAL JOURNAL IN GERMANY.—Sometime ago we printed a note from a foreign contemporary reporting that an electrical journal was about to be published in Berlin in the English language. In reply to an inquiry we are informed from Berlin that the only foundation for the story appears to be that "a prominent electrical journalist was in Berlin for several days some weeks ago and appeared to be very busy and interested in something which people generally did not understand. Nothing can be learned from those who would be most likely to know if such a plan were on foot."

IMPROMPTU SURGERY.—At Vallejo, Cal., recently, an ingenious application of electricity to surgical operations was demonstrated. An apprentice at the navy yard was severely injured by a piece of steel, which flew from a tool, embedding itself in his face. It was thought that the metal had been entirely removed from the wound, but there were indications of the presence of a foreign substance. Master Electrician Petrie arranged an electromagnet of his own design capable of lifting 500 pounds. The magnet was held directly over the orifice of the wound and the current was turned on. In an instant the piece of metal was drawn from the wound and attached itself to the magnet.

THE NERNST LAMP PATENT IN GERMANY.—The Imperial Court (First Civil Senate) of Germany has reversed on appeal a decision of the German Patent Office against the validity of the Nernst patent. The complainant in the proceedings before the Patent Office was William Boehm, a chemist, who contended that the invention of Nernst was anticipated by Jablochkoff. In 1877 a German patent was issued to the latter, the specifications of which disclosed that if an insulating substance such as kaolin is introduced into a high-voltage circuit and becomes heated "under the influence of sparks" the passage of current is permitted and the material becomes incandescent. This patent and subsequent publications on the work of Jablochkoff formed the principal issue. In rebuttal it was claimed that the main principle of the Nernst lamp was a preliminary heating by external means, and this was upheld by the court, which, as stated above, reversed the decision of the Patent Office.

LETTERS TO THE EDITORS.

A Correction.

To the Editors of Electrical World and Engineer:

SIRS:—On page 832 of your issue of May 16 a statement is made purporting to give my views as recently stated before a meeting of the American Institute of Electrical Engineers, at Chicago, in favor of direct-current power houses for railways, and which would lead one to believe that I have recently changed my opinions regarding the advisability of the use of alternating current for heavy railway work.

What I meant to convey by my remarks, and what I believe should have been understood from what I actually said, was that I believed in a number of alternating-current power houses, distributed along the line, feeding alternating-current directly into the working conductor at a sufficiently high pressure to allow these power houses to be located a reasonable distance apart; for by so doing, the use of step-up and step-down transformers, rotary-converters, and the entire sub-station equipment would be eliminated. This, of course, assumes the use of alternating-current motors on the cars, the practicability of which I think will soon be demonstrated. Since I have so strongly advocated the use of alternating-current motors for railway work, for some years, and am still in favor of them, I dislike to find myself quoted as being apparently against them.

I shall be obliged if you will kindly rectify the error in some suitable manner.

CHICAGO, ILL. BION J. ARNOLD.

How to Produce Gravity Experimentally.

To the Editors of Electrical World and Engineer:

SIRS:—The article on "How to Produce Gravity Experimentally," by Mr. Robert Stevenson, C. E., published in your issue of the 16th inst. certainly contains some remarkable statements; and if the facts are as the author says they are, they are certainly contrary to the accepted laws of motion. As, however, Mr. Stevenson admits that he is at variance with all the authorities, he will perhaps pardon my temerity in saying that I think he is entirely mistaken in his observation of the motion of the water after it has left the nozzle.

I have not tried the experiment in the precise form described, but I have tried an approximation to it with an ordinary hose. If the nozzle of an ordinary hose be held in the hand and moved as nearly as possible in a circular orbit, while the flow of water is at the same time properly regulated with the stop-cock, it is an easy matter to throw the ejected water into a helical or helicoidal form; but this is a very different thing from causing the individual particles of the water to move in helicoidal paths. Each elementary portion of water travels in a trajectory identical, or at least sensibly so, with the one it would have traveled had the nozzle been held stationary at the point where the given portion of water was ejected.

The appearance of a helix rotating upon its axis without motion as a whole in the direction of the axis, and of a similar helix moving bodily in the direction of its axis without rotation, are sometimes so similar that it is difficult to distinguish between them. A particular case in point, in the writer's experience, is that of a sub-marine cable passing through the armoring machine. At a point just beyond that where the armor wire was "closed" upon the core the eye was unconsciously arrested by a stationary portion of the machine, so that the observation was continually directed to successive portions of the armor. This, owing to the helical lay of the armor wire, produced the appearance of axial rotation. So persistent was this illusion, that it was only dispelled by grasping the cable in the hand, when the eye unconsciously followed the hand, and the attention was directed to a single point of the armor. The dis-illusionment was instantaneous.

NEW YORK. TOWNSEND WOLCOTT.

Dimensions of Physical Quantities and Abbreviations of Units.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of January 5, 1901, there appeared a sheet of the "Symbols of Physical Quantities and Abbreviations for Units, recommended at the International Electrical Congress, 1893." I have noticed some more or less evident mistakes in this table and thought

perhaps it might be well to call your attention to them, although it is probable you have already noticed them. They are as follows:

A. The defining equation for acceleration should be $a = \frac{v}{T}$, and its dimension should be $L \times T^{-2}$.

B. The coulomb is an ampere-second, the abbreviation being *a-s.*

C. The joule is a watt-second; abbreviation, *w-s.* Yours truly,

CHICAGO, ILL. H. H. WAIT.

[*A* is a valid statement and criticism, the error noted being due to a misprint. Another error which crept in the table is the definition of frequency, which should be $\frac{n}{T}$, and its dimension, T^{-1}. As to *B* and *C*, the table does not undertake to establish the relation of the coulomb and ampere-hour, which are correctly treated as independent units. It implies that both the coulomb and the ampere-hour are units of quantity, which is true. Similarly, no intention existed to demonstrate the relation of the joule and watt-hour. It appears probably that some action will be taken at the coming St. Louis International Electrical Congress with respect to electrical nomenclature and symbols, in which case a revised version of the table will be printed in these columns.—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motors with Commutator.—BLONDEL.—The first parts of what appears to become a very long serial on the theory of induction motors, provided with a direct-current commutator. Rotten was the first who, in 1891, patented such a machine; Goerges described such a machine later in the same year. The recent development is due to Heyland and Latour, as was stated frequently in the Digest. The present author gives first a description of the Goerges motor, together with a very full analytical theory, illustrated by a series of diagrams. He then takes up the Latour arrangement. As the first two parts of this serial fill 34 pages, it is impossible to give a brief summary. The author criticizes various previous remarks of both Heyland and Latour.—*L'Eclairage Elec.*, April 25, May 2.

REFERENCES.

Theory of the Single-Phase Induction Motor.—CAHEN.—A reply to a remark of Goerges, who had stated that the conception of a single-phase alternating-current field being the resultant of two equal imaginary revolving fields, which rotate in opposite directions, is not very easy to grasp, and leads to inexact results. The present author denies emphatically the exactness of the latter criticism and shows that if the method is correctly applied, it leads to correct results.—*Elek. Zeit.*, April 30.

Three-Phase Alternator.—DOANE.—A didactic article, illustrated by diagrams.—*Elec. Age*, May.

LIGHTS AND LIGHTING.

Osmium Lamp.—KUBES.—An article on the osmium lamp, in which, after some brief remarks on its manufacture, the following data are given of its behavior. On account of the small current consumption of the osmium lamp, compared with the carbon filament lamp, a saving of 50 to 56 per cent. is effected. Concerning the constancy of the light, it is stated that the ordinary incandescent lamp loses about 15 to 20 per cent. of its initial candle-power after 500 to 600 hours of burning, while the osmium lamp gains a few per cent. during the same time, and only after 1,000 hours it begins to lose a comparatively small proportion of its candle-power. The average life of the lamp has been given by the manufacturers as 500 hours, but in recent tests a large percentage of lamps is said to have had a life of 2,000 hours. The end of the life of the lamp is due to the burning through of the filament. In one test the original candle-power was 33, with a consumption of 1.54 watts per candle; after 500 hours, 32.4 candles and 1.49 watts per candle; after 1,000 hours, 31.7 candles and 1.5 watts per candle. In another test the candle-power was at the start 34.7 candles, with 1.5 watts per candle, after 600 hours, 31.8 candles and 1.54 watts per candle; after 900 hours, 31.6 candles and 1.58 watts per candle. The decrease of candle-power was, therefore, at the maximum still below 9 per cent. after 1,000 hours, while the watt consumption increased only by 3 per cent. Two tests made in Nüremburg with 32 and 25-candle lamps are described, in which the 32-candle lamps behaved in a peculiar way, as their candle-power first decreased, then increased again above the normal value and finally remained nearly constant; the candle-power of the 25-candle lamps first increased considerably and later decreased gradually. In both types of lamps the watt consumption per candle became smaller, with a greater candle-power. It follows that when overloaded the lamps show a lower watt consumption. Osmium lamps stand overloading better than ordinary incandescent lamps, although the life is diminished. The disadvantages of the osmium lamp are its low voltage and the fact that it must be used in a downward position, as the filament is strongly bent when the lamp is lighted. The commercial lamps are sold for 16 volts at 10 and 16 candles, 25 to 3 volts at 25 candles, 27½ volts at 16 and 25 candles, 32 to 44 volts at 25 to 32 candles. The inventor hopes that at some future time he will be able to place commercial lamps for 110 to 120 volts on the market. The supply of osmium is small, and the price of the lamp is, therefore, high, namely, $1.25; 19 cents are given back, if the burned out but unopened lamp is returned within 18 months. The filament of such a lamp can be treated and used again.—*Zeit. f. Elek.*, April 19.

Osmium Lamps for Train Lighting.—BREIDENSPRECHER.—A note on the lighting system which has been in successful use on passenger and freight trains of the Marienburg-Mlawka Railway in Germany, since 1894. The current is derived from storage batteries carried on the train. As the incandescent lamps formerly used were not very durable and showed a diminution of their lighting power towards the end of their life, osmium lamps were substituted since the beginning of August, 1902; they gave 10 cp at 16 volts, and the calculated energy consumption was 1.5 watts per candle-power. The storage batteries then required recharging after 72 hours, whereas with the old lamps they had to be recharged after 32 hours, the final voltage being in both cases the same. After burning 750 hours, no diminution in the light could be observed in the osmium lamps, the bulbs of which kept perfectly clear while those of the carbon lamps had blackened. The vibrations of the trains did not affect the lamps. For the ordinary incandescent lamps, with an average life of from 300 to 400 hours, 22.5 cents was paid; for the osmium lamp, with an average life of 1,000 hours, the cost was $1.19; the cost for depreciation was, therefore, 0.056 cent for the old lamp and 0.119 for the osmium lamp.—Lond. *Elec*, May 1.

Life of Nernst Lamps.—With reference to some recent discussion of this subject, the experience of the electrical engineer in Gravesend is quoted; he installed 48 Nernst lamps of 0.5 amp. in place of incandescent gas burners, and the average life at the end of three months was 960 hours, individual burners lasting over 165 hours; the 960 hours do not represent the true life, as at the expiration of the three months there were of course 48 burners alive. From a report of another engineer who installed three sets of six lamps each, it appears that the average life of one set was 836 hours, of another 575 hours, and of the third 652 hours.—Lond. *Elec.*, May 1.

REFERENCE.

New Incandescent Lamps.—HAMMER.—A section of his recent Franklin Institute Lecture on "recent electrical and scientific developments abroad" deals with the three-phase lamps of Ganz & Co., and the Coruto Co., such as are used on the Valtellina Railway and with the osmium and Nernst lamps.—*Jour. Frank. Inst.*, May.

POWER.

Electricity in Mining.—An account of the proceedings at a recent meeting of the English Department Committee inquiring into the application of electricity in mines. Of special interest is the examination of Bigge concerning the respective merits of direct-current

and three-phase working. He was most emphatic in his advocacy of the latter system and said that one might even work with considerably higher pressure, yet there is less danger of break-down, one reason being that there is a smaller difference of potential between adjacent windings of the rotor. The simpler and stronger construction of the three-phase motor and the ease with which it may be repaired, are great advantages. Combined with the question of economy is that of whether high pressures should be brought down the shaft of a mine; he claims that the workmen are more careful when they know that contact means certain death and that there are, therefore, actually less fatalities in connection with high-tension than with low-tension systems.—Lond. *Elec.*, May 1.

Water Power in Electrical Supply.—ADAMS.—An article giving some statistical notes. Electrical supply from transmitted water power is now distributed in more than 50 cities in North America; some instances are mentioned. For comparison of the expansion of electric waterpower systems with those operated by steam, when located in different cities, statistical data are given on the electric supply development in Hartford and Springfield on the one hand, and in Fall River and New Bedford on the other hand; the conclusion is drawn that water power has been the most potent factor in the comparatively very large rise of electric loads in the two former cities. He also mentions that the application of transmitted water power in electrical supply, has displaced steam as a motive power in many large industrial plants that never would have been operated from steam-driven electric stations; he quotes some instances. He believes the development of water powers will continue to increase and that in another ten years the greater part of electrical supply on the American continent will be drawn from water.—*Elec. Rev.*, May 9.

REFERENCES.

Canadian Water Power Plant.—A detailed, well-illustrated article on the water power development at Chaudiere Falls, P. Q. At present two revolving-field, 750-kw alternators have been installed, the voltage being 10,500 and the frequency 66⅔. The power transmission by subaqueous cable to the transformer sub-stations at Levis, is also described.—*Eng. News*, May 7.

Electrically-Operated Milling Plant.—PERKINS.—An illustrated description of a power plant recently installed in Scotland for transmitting electric power to various mills and factories in different sections of the city. The total capacity is 2,000 hp, each of the half dozen concerns requiring about 300 hp. Direct current of 500 to 530 volts is used.—*Elec. Rev.*, May 2.

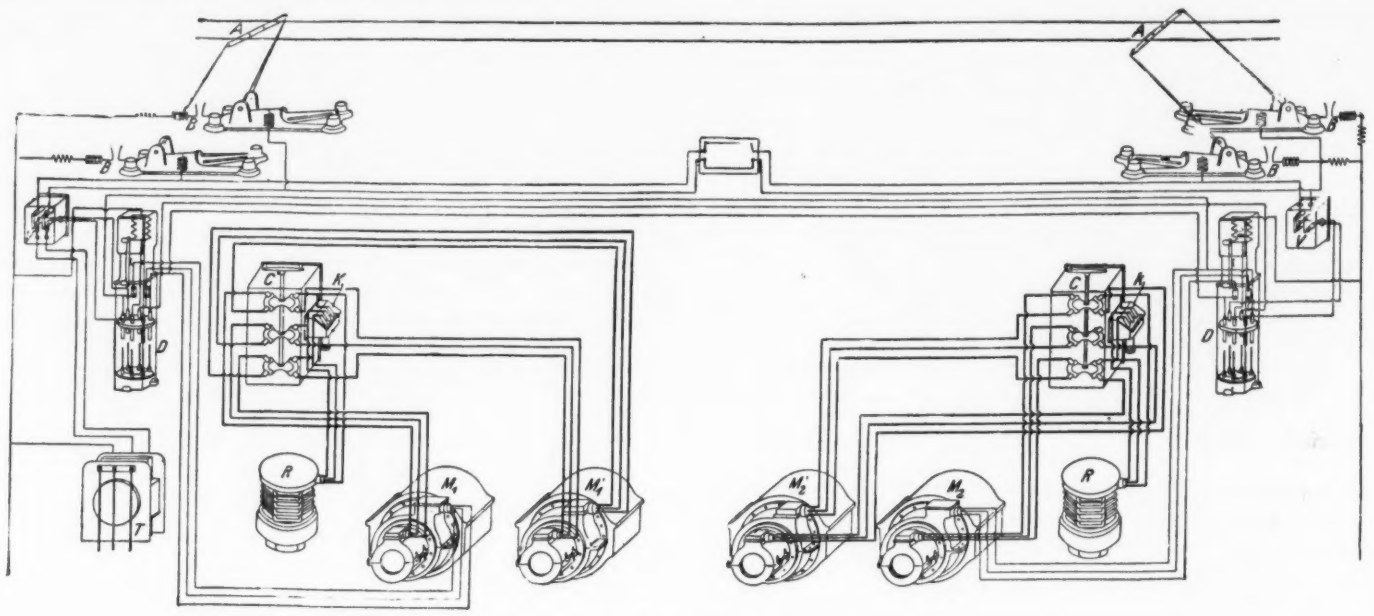
Steam Turbine.—An illustrated description of the Rateau turbine, for which, in spite of considerable friction on the surfaces of the disks in the chambers, an efficiency is claimed considerably higher than that of the best compound engine using superheated steam.—*St. R'y Jour.*, April 18.

Electric Equipment of Bridges.—An illustrated description of the electrical equipment of two new rolling-lift bridges in Chicago, direct-current tramway motors being used in both cases.—*West. Elec.*, May 9.

Steel Plant.—PERKINS.—An illustrated article on central power stations at iron and steel plants.—*Elec. Age.*, May.

TRACTION.

Valtellina Three-Phase Railway.—CSERHATI.—The conclusion of his detailed profusely-illustrated description of the Valtellina high-tension, three-phase railway system. The construction of the motor cars and locomotives is described and illustrated. At present motor cars are used for the passenger service and locomotives for the freight service; but it is intended to use electric locomotives for the large passenger express trains, also for a speed of 60 to 70 km on a grade of 1 per cent. for trains up to 250 tons, and with a speed of 35 km for trains up to 400 tons. These locomotives will have to develop a tractive effort of 9,000 kg in starting. The motor cars now in use weigh 53 tons each, and are able to draw a train of five to seven passenger cars having a total weight of 150 tons, on a grade of 1 per cent., with a speed of 65 km per hour. There are 10 such motor cars in use, each having two bogie trucks; each truck is provided with two axles, on each of which one three-phase motor is mounted. One motor of each bogie truck is the high-tension motor, the other a 300-volt auxiliary motor for use in starting, braking and for mounting steep grades. At these times the two motors are connected in cascade (in tandem), the high-tension, three-phase currents being supplied to the stator winding of the primary motor, while its rotor winding is connected with the stator winding of the second motor. The primary motor is so designed that its rotor gives 300 volts for running in tandem. The rotor circuit of the second (auxiliary) motor is closed by a resistance, which is gradually disconnected, and which is short-circuited when the motors have reached tandem synchronism, namely one-half full speed. The starting of the motors, the raising of the liquid in the rheostats, the raising and lowering of the trolley poles and the operation of the Westinghouse brakes, are all done by compressed air. When a motor car starts, the tandem connection is used; at the short-circulating of the rheostat one-half full speed is reached. The auxiliary motor is then disconnected from the circuit and the same rheostat is connected to the slip-rings of the high-tension motor and is gradually short-circuited. The controller handle has three positions: in the first the motors are disconnected, in the second the motors are connected in tandem and the terminals of the rheostat are connected with the slip-rings of the second (auxiliary) motor; in the third the auxiliary motors are disconnected and the slip-rings of the high-tension motors are connected with the rheostat. The operation of the gradual disconnection of the rheostat takes place automatically. The wiring diagram of the motor car is given in the adjoining diagram. From the trolley poles, *A*, the current passes



VALTELLINA THREE-PHASE RAILWAY.

to a distributing box, *V*, which contains the contacts, by the removal of which the electrical connection of the trolley poles with the circuit of the car is interrupted. *B B* are lightning arresters. *D* is the main switch, *C* the controller, *K* a short-circuiting switch, M_1, M_2 the high-tension motors, M'_1, M'_2 the auxiliary 300-volt motors, *R R* liquid rheostats, *T* a transformer for the air pump, lighting and heating. The arrangement in the locomotives is similar to that of the motor cars.—*Elek. Zeit.*, April 30.

Double-Unit System.—An illustrated article on the Paris Metropolitan Railway. Eight-car trains are used, with one motor car at the front and another at the end, and what is called the "double-unit system" of control is used. Each motor car, if used with three trailers, can be controlled by the usual series-parallel control of its two motors; in an eight-car train the two pairs of motors are connected in series or parallel from the controller of whichever car happens to be in front for the time being, the resistances of this car only being utilized. Current is supplied to the line at 500 volts, partly generated directly at the company's own power house and partly supplied in form of three-phase currents transformed in converter substances.—Lond. *Elec.*, April 24.

Steam Turbines in Traction Plants.—An editorial on steam turbines for interurban railways. The weak point in the present steam turbine is said to be its high speed, as for instance 1,800 revolutions for a 500-kw turbine or 500 revolutions for a 5,000-kw turbine, for which speeds it is difficult to build a direct-current generator. The result is that turbines so far have been constructed entirely for alternating-current work; but even if no reduction in speed is possible, the turbine will still be used largely in railway service.—*St. R'y Jour.*, April 25.

Paris.—An article on extensions which are being made to the Metropolitan Underground Railway in Paris. All of the surface tramways demand the introduction of the trolley and estimate that the saving with the trolley over the accumulator cars would amount to 222,000 francs per annum. Another aspect of the Metropolitan competition with the tramway and omnibus companies is shown by the decrease in the number of horses, which is 6,000 less than two years ago. An underground double-track road between Antwerp and Brussels is proposed; the line would be 42 km in length and the distance would be run in 22 minutes.—*St. R'y Jour.*, May 2.

REFERENCES.

Electric Traction.—A long article giving trade notes on tramway and railway cars, car equipments, lines and feeders, engines and generating plant, batteries, switchboard instruments and telephones.—Lond. *Elec.*, April 24.

Electric Railway Power Distributions.—GUMP.—An article illustrated by diagrams, in which he discusses the various factors which enter into the design of an electric railway power distribution system. The subject is discussed under the following heads: Grading and drop of voltage; load curve; feeders; return circuit; bonding; power plant; electrolysis.—*West. Elec.*, May 9.

Wooden Blocks as Insulators for Third Rail.—LEAVITT.—An account of tests of the wooden insulators used on the third rail of the Albany & Hudson Railway, showing in a table the ampere losses and the conditions as to moisture. He believes wooden insulators to be perfectly satisfactory.—*St. R'y Jour.*, April 18.

Vatellina Three-Phase Railway.—HAMMER.—A part of his Franklin Institute lecture on "recent electrical and scientific developments abroad" deals with this railway—*Jour. Frank. Inst.*, May.

Washington, Baltimore & Annapolis Road.—A summary of the plans for the roadbed and overhead construction in the transformation of this installation, which is to be equipped with the Lamme single-phase system.—*St. R'y Jour.*, April 25.

Conduit System in London.—The first part of a detailed and well-illustrated description of the conduit system used by the London County Council tramways.—Lond. *Elec.*, April 24.

Rockford, Beloit & Janesville R'y.—An article on the main power plant and distribution system of this interurban system in Wisconsin, with data upon the performance of the power plant and general operating statistics.—*St. R'y Jour.*, April 25.

Ohio Central Traction System.—A description of the interurban line extending from Bucyrus through Galion and Crestline to Mansfield, Ohio; it is to form an important part of the Cleveland & Southwestern system, which will ultimately furnish a complete electric trunk line between Cleveland and Columbus. The maximum grade is only 2 per cent. The most important feature of the equipment is the steam turbine, which has just been installed.—*St. R'y Jour.*, April 25.

Car Shops.—A description of the car shops of the Rochester Railway, which are equipped for all classes of construction and repair work. Power is furnished by electric motors, but compressed air is also extensively used.—*St. R'y Jour.*, April 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Kansas City.—A well-illustrated description of the Central Avenue Station in Kansas City. There are two 1,500-kw, 6,600-volt, three-phase, 25-cycle generators, this low frequency being chosen on account of its adaptability to motor and railway synchronous converter sub-station service. As this frequency is too low for satisfactory lighting, 2,300-volt, 60-cycle, two-phase generators, direct-connected to 6,600-volt, three-phase, 25-cycle synchronous motors, are used to supply the lighting service.—*Power*, May.

REFERENCES.

Voltage Regulation in Networks.—HIECKE.—An illustrated paper, read before the Vienna Electrical Society, in which he describes the methods used in the central stations and in the three and five-wire networks of the General Austrian Electric Company, for keeping the voltage constant. In order to measure, in the stations, the voltage at the distant feeding points, each feeding point is connected with the measuring instruments in the stations by means of pilot wires which are placed in the feeder cables. Descriptions are given of the instruments and of the various methods of regulating the voltage by means of change of speed and by varying the exciting current of the steam dynamos, by varying the number of cells of the storage batteries, and by means of balances. The method used for starting up operation after an accidental closing down is also described.—*Zeit. f. Elek.*, April 19.

Distribution Losses and Resonance Phenomenon.—An account of the discussion of the two papers by Constable and Fawsett on distribution losses in electric supply systems, and by Field on a study of the phenomenon of resonance in electric circuits with the aid of oscillograms; both of which were recently noticed in the Digest.—Lond. *Elec.*, April 17, May 1.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Determining the Distribution of Currents in Electric Networks.—TEICHMUELLER.—A long communication, in reply to Herzog and Feldmann, concerning the further development, by the latter authors, of an older method of Kennelly, another method of Frick and another method of Coltri.—*Elek. Zeit.*, April 30.

Capacity of Cables.—ANDRIESSEN.—A mathematical article on the determination of the capacity of cables by decomposing it into partial condensances. The case of a two-core cable is fully treated and a few remarks are added on polyphase cables.—*Elek. Zeit.*, April 30.

ELECTRO-PHYSICS AND MAGNETISM.

Pulsating Direct Currents in the Alternating-Current Arc.—MONASCH.—An illustrated paper read before the Darmstadt Electrical Society. In view of the applicability of the Cooper Hewitt mercury arc lamp for converting three-phase currents into pulsating direct current, the author gives a review of the former work of other investigators on pulsating direct currents in the alternating-current arc. Jamin and Maneuvrier were the first who found that from the alternating-current arc direct current can be taken, which produced electrolytic action. A summary is then given of the investigations of Sahulka, Gold, Lang, Eichberg and Kaller, Blondel, Duddell and Marchant, Arons, Mrs. Ayrton and others. The Cooper Hewitt invention is an interesting generalization of our knowledge of pulsating direct current in the alternating-current arc, because his arcs are very long compared with those of Blondel, and also because Cooper Hewitt gets a pulsating direct current in an alternating-current arc between two different metallic electrodes, while this phenomenon has, up to the present, been observed only between metal and carbon or between carbons of different natures and diameters.—*Elek. Zeit.*, April 20.

Electric Conduction.—STRUTT.—A note on a Royal Institution lecture on some recent investigations of electrical conduction. He made an experiment in which a Röntgen ray tube placed in the gallery of the lecture hall, discharged a gold-leaf electroscope near

the lecture table. He then showed how ionized air would discharge the electroscope, even when the instrument was shielded from the direct action of the Röntgen rays. The Crookes tube was placed in a leaden box with a window, and another leaden box, having an aluminum window, was held in front of it; air was passed through this box by means of a pair of bellows and a rubber tube, and when allowed to play on the knob of a gold-leaf electroscope, effectually discharged it. Curves, representing the relations between current and e.m.f. in cases of such discharge, are straight lines for metals, while charged gases appear to become, as it were, saturated at a certain potential, the curves bending over and becoming almost horizontal from a particular value onwards. Taking air as unity, the relative saturation currents for Röntgen rays are for hydrogen 0.1, sulphur dioxide 8.73, and methyl iodide 70.3; and for Becqueral rays hydrogen 0.16, sulphur dioxide 2.32, methyl iodide 5.18. He then described Wilson's apparatus and experiments demonstrating that a discharge takes place in a closed vessel; he thinks the discharge may be of Becquerel rays from the walls of the vessel itself.—Lond. *Elec.*, May 1.

Coherer.—HANCHETT.—A short article on a simple microscopic experiment of coherer actions. From his observations he draws the following conclusions as to the requirements for a good coherer. The particles used should be "impervious to oxidation"; they ought to be as light as possible; aluminum would be very good if it had not the well-known oxide film on its surface. The number of filings in the coherer should be the smallest possible.—*Elec. Rev.*, May 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Ions in Solution.—KOHLRAUSCH.—A paper in which he advances a new hypothesis concerning the nature of mobility, based on the latest values of ionic mobilities. He suggests that the ion carries with it a mass of adhering solvent or "atmosphere" which for multivalent or compound ions differs from that of monatomic ions. He thus attempts to reduce the properties of ions in electrolytes to one fundamental element, namely their hydration or power of forming such an atmosphere. This water atmosphere varies with the nature of the ion, but enough is not known about the molecular forces to describe this more definitely. If the electrolytic resistance is in reality a mechanical friction, it follows that the mobilities of all the ions tend toward zero at about minus 40°.—*Proc. Roy. Soc.*, April 7; abstracted in Lond. *Elec.*, April 24.

Decay of Metals.—MILTON AND LARKE.—An abstract of a paper read before the British Institution of Civil Engineers on some experiments made to determine the galvanic action between copper, iron, brass, Muntz metal, etc., when in contact with sea water. Weak but long-continued applied currents had a decided corrosive action upon copper and its alloys, which was greater in those containing the most of copper. With a current of 0.001 amp. acting on an immersed area of 40 sq. cm in the case of Muntz metal, the wasting was confined to the de-zincification of that poorest in copper; but the same current, acting upon 60 sq. cm of ordinary brass condenser tubes, caused a fairly uniform corrosion of both the copper and the zinc. It seemed that decay was more frequent in metals which had a duplex or more complex structure than in the more homogeneous, and was due to a slower or less energetic action than that causing corrosion; moreover, it involved an action which removed only a part of the constituents, whereas corrosion might result from chemical action alone, or both combined. Pitting was probably often due to local segregation of impurities of the metal, but it might also be due to local irregulariaies of the surface or structure which produces local irregularities in the distribution of galvanic currents. In the case of brass exposed to sea water, tin was distinctly preservative, while lead and iron were both injurious, rendering the brass more readily corrodible. Electrolytic action alone, produced with applied currents, even when they are exceedingly minute, might produce very severe corrosion or decay; every effort, therefore, should be made to prevent such action by careful insulation of all electric cables. Whenever galvanic action is inevitable through the proximity of different metals exposed to the same electrolyte, zinc plates should be arranged so that they would be negative to both of the other metals.—Lond. *Elec.*, April 24.

Electrogalvanizing.—COWPER-COLES.—Some notes on electrozincing as used extensively in shipbuilding yards for coating steel plates and boiler tubes. When properly done, the results are claimed to be excellent, but sometimes work may look well, although when tested it is found to be only thinly coated with zinc. An electrogalvanizing plant should be practically automatic, so that it can be put in charge of any intelligent workman, and this, he says, is accomplished by substituting insoluble lead anodes for those of zinc and replenishing the bath by passing it over filter beds containing zinc powder or dust. A recently installed plant in London, in which this is done is described.—Lond. *Elec. Rev.*, April 24.

REFERENCE.

Electric Steel Process.—BEECKER.—An illustrated article on the Kjellin electric steel process in use at Gysinge, Sweden.—*L'Ind. Electrochimie*, March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Maximum Demand Indicator.—An illustrated description of a maximum demand indicator, consisting chiefly of a differential thermometer, which acts on a novel principle whereby a drop of mercury contained in a glass tube, having a bulb blown at each end, is caused to act both as a gas valve and also as a registering index of the maximum dhifference of temperature to which the bulbs have been subjected. The lower cylindrical bulb is closely embraced by a helical heating resistance wire, which is connected to the terminals of the current by two spring blades, which tend to close the helix and so cause it to grip the cylindrical bulb closely and insure good and uniform contact between the heating surface of the resistance wire and the glass bulb. The expansion of gas in the lower heated bulb causes a definite transference of gas into the upper bulb, corresponding to any given current, and on removing the thermometer from the heating helix, or switching off the current, the contraction of the gas in the lower bulb, or cooling, causes the mercury to sink downwards in the stem to a point determined by the total volume of gas originally transferred during the heating process; the drop of mercury acts as a valve. The tube carries a fixed scale marked in amperes or otherwise, and the mercury thus forms an index of the maximum current passed through the heating wire. Should the heating wire be broken or get burnt through by a short circuit or excessive current, the spring terminal blades to which its ends are attached instantly close together and short-circuit the instrument, thereby preventing a failure in the service. The instrument is said to be compact and low in price.—Lond. *Elec.*, May 1.

New Books.

ELEMENTARE VORLESUNGEN UBER TELEGRAPHIE UND TELEPHONIE. By Dr. Richard Heilbrun. 3 lieferung. Berlin: Georg Siemens. Complete work, 11 marks.

The author of this brochure has compiled a description of the various kinds of batteries that are used in telegraphy and telephony. At the beginning of the pamphlet the chemical theory of the various cells is taken up and discussed at length, while subsequently all of the modern forms are illustrated in detail. Finally, a description of storage batteries and discussion upon the methods of making plates, completes the book.

Self Cooling Transformers.

The accompanying illustrations show the latest type of Westinghouse oil-insulated and self-cooling transformer. In this type of transformer both high-tension and low-tension windings are divided into many flat coils. The high-tension conductor, in all transformers except the very small sizes, is a flat copper ribbon wound concentrically with only one turn per layer. The layers are separated from each other by a specially prepared insulating material in addition to the cotton covering of the conductor, while the coils are insulated individually and are separated by heavy insulating washers. This form of construction is such as to practically eliminate any danger of break-downs between layers or from turn to turn—one of the most common troubles in transformer operation.

The low-tension side is wound in the same way with conductors of rectangular cross-section. In the larger transformers many wires are paralleled and are arranged in such a manner as to eliminate eddy currents in the conductors.

The advantages of this improved method of winding employed in the oil-insulated self-cooling transformer may be summed up as follows:

(1) The total e.m.f. of the transformer is divided among many coils, reducing proportionately the strain within an individual coil. (2) The e.m.f. between layers is reduced to that of a single turn (ranging from 10 to 25 volts). (3) The coils may be spread apart

at the ends so that a very large surface is exposed to the oil, thus providing ample radiating facilities. (4) The regulation of the transformer is greatly improved by the interlacing coils which is permitted by this method of construction. (5) In case of damage to a coil another one may be substituted with little trouble and without returning the transformer to the works.

Oil passages or ventilating ducts between the coils and in the iron provide an even heat distribution and a consequent uniformity of temperature throughout the transformer. The arrangement of these ducts between the coils is such that when the transformer is operated, a vigorous circulation of oil is set up directly through the interior of this winding, and the ducts placed at frequent intervals between the laminations bring rapidly moving oil within less than one inch of every particle of iron in the transformer.

The amount of heat developed in a transformer depends upon its capacity and efficiency. In a 500-kw transformer of 98.5 per cent. efficiency there is a loss at full load of 7½ kw or 10 hp. Since this loss appears as heat, it must be disposed of, to prevent a dangerously high temperature.

This heat may be dissipated by simple radiation from the surface of the containing case; by the circulation of water through pipes immersed in oil, or by the constant removal of heated oil and its

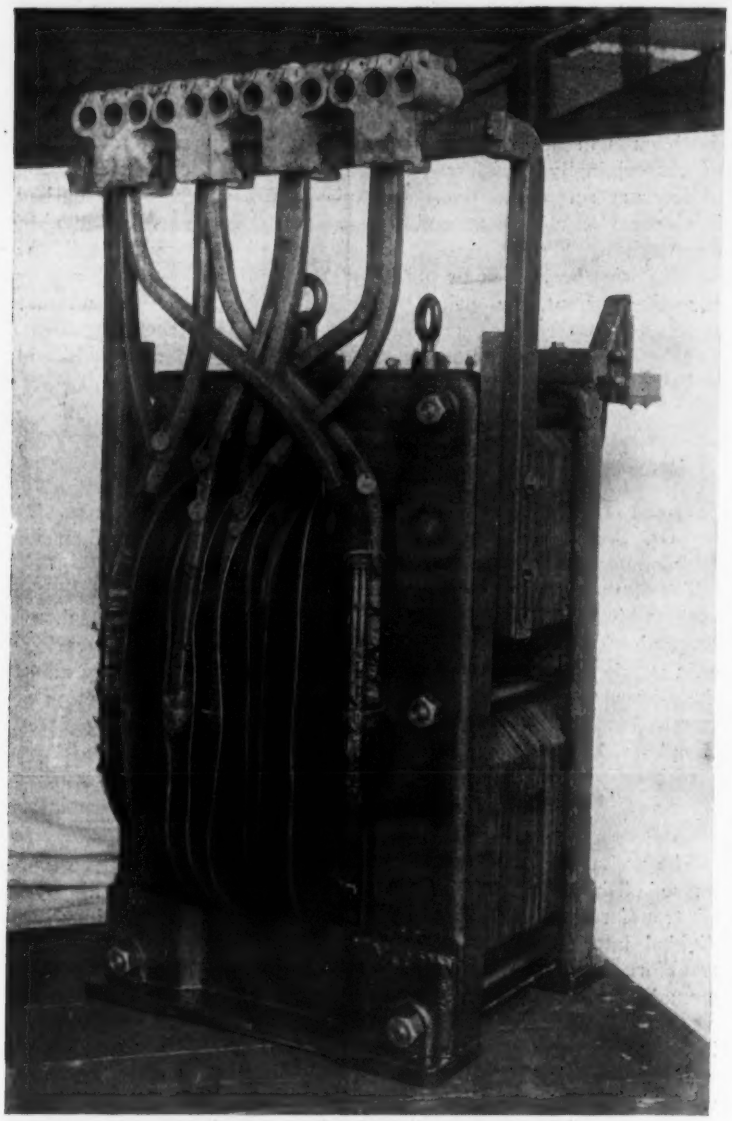


FIG. 1.—OIL-INSULATED TRANSFORMER.

return after having been cooled. The advantages of the first simple method are obvious.

To dispel the heat generated in a transformer of the self-cooling type a case with a large surface area exposed to the air is required. The greater the radiating surface, the lower the temperature. The Westinghouse transformers are mounted in heavy sheet-iron cases protected by an outer framework of angle iron. The surface area of the case is increased by corrugations, and is capable of radiating an immense amount of heat.

The high-tension terminals are mounted on a marble slab at one end of the transformer, the leads being brought out through bushings. The low-tension terminals are mounted at the opposite end of the transformer on a steel bar heavily insulated with mica, making an entirely safe construction.

In large transformers for long-distance transmission, close regulation is of even greater importance than in the ordinary small transformer for lighting circuits, as the drop in the line is often of con-

FIG. 2.—OIL-INSULATED TRANSFORMER.

siderable magnitude, and with raising and lowering transformers the transformer drop occurs twice between the generator and the load. This drop is greatly increased when the power factor of the load falls below unity, as it does where current is supplied to induction motors. It is, therefore, particularly necessary that close regulation be obtained in transformers designed for transmission work, especially if used for supplying motors. This point has received careful attention in the design of the transformers described, and the highest practicable standard of regulation has been attained.

Oil-insulated self-cooling transformers may be wound for practically any voltage desired. The following high-tension voltages, however, have been adopted as standard: 2,200, 6,600, 11,000, 16,500, 22,000, 33,000 and 44,000. Taps are brought out from the high-tension winding for three lower voltages. This provision makes it possible to use duplicate transformers at both ends of the transmission line, the taps on the lowering transformers accommodating them to the reduced line voltage. The following table shows the exact voltages for which Westinghouse standard transformers are wound, the capacities being from 10 to 500 kw:

STANDARD VOLTAGES FOR OIL-INSULATED SELF-COOLING TRANSFORMERS.

2200	6600	11000	16500	22000	33000	44000
2100	6300	10500	15750	21000	31500	42000
2000	6000	10000	15000	20000	30000	40000
1900	5700	9500	14250	19000	28500	38000

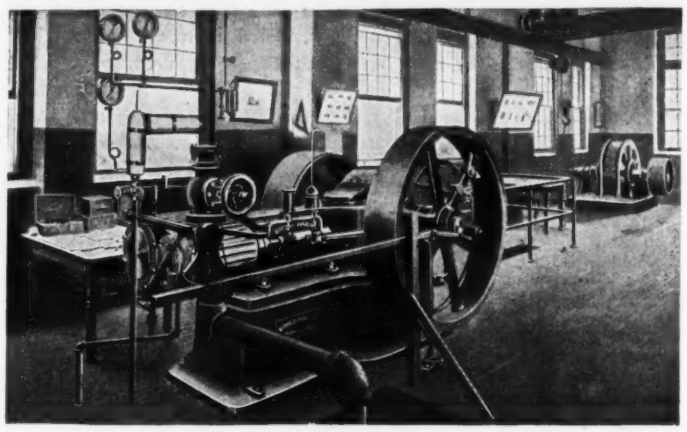
Transformers of a capacity not exceeding 150 kw may be wound for voltages as low as 50, and the larger transformers for voltages as low as 100. Either or both windings may be divided into two equal parts so arranged as to permit either series or multiple operation, the change being effected by a simple rearrangement of connectors on the terminal block. Taps may be brought out from the low-tension winding for ample variation in both voltage and ratio, and are provided for a total of five voltages—full voltage, 5 per cent. and 10 per cent. less than full voltage; half voltage, and 5 per cent. less than half voltage.

A Comprehensive Engine Test.

Profs. Reeve and Allen, of the Worcester Polytechnic Institute, have made in the power house of that institution a comprehensive series of tests for the Buffalo Forge Company on a 12-in. x 12-in. single-cylinder engine, which are models of what engine tests should be. Below we give an abstract of the report on the tests:

The engine tested is a single-cylinder, horizontal, center-crank, shaft-governor engine, having a cylinder measuring 12 x 12 in. and scheduled to run at 300 r.p.m. It was erected upon temporary foundations on the power house floor and belted to a quill upon the main line shaft. Steam was drawn from the vertical boilers through 36 ft. of permanent covered pipe and 17 ft. of temporary naked piping. The exhaust was led through three elbows and 14 ft. of pipe into a surface condenser with which all other connections were broken. During the tests the quality of the steam at the throttle was observed many times by means of a throttling calorimeter. The condition of the steam supplied to the engine was frequently investigated. It was at all times practically dry saturated steam.

In order to insure absolute steadiness of power developed, the engine's governor was blocked into such positions as would give the various cut-offs desired. The speed was maintained constant by insuring that the load was at all times greater than that which the engine would drive, the balance being made up by a second engine belted to the same line shaft. The governor of this second engine performed the regulation for the entire system. The speeds recorded are, therefore, no record of the action of the governor of the engine. The variations between the several tests are due to variety of adjustment of the governor of the second engine and of the load be-



ENGINE TEST.

tween the two engines. During any one test the speed was sensibly constant.

During all of the tests all of the exhaust from the engine was condensed in the surface condenser and the steam consumption was taken as its weight. During all of the non-condensing tests, care was taken that the pressure within the condenser was just atmospheric, while at the same time no vapor was allowed to escape. During the condensing tests the vacuum maintained in the condenser, about 22 in., was the best that could be, in view of the limited size of the condenser. This arrangement left the steam pressure as the only variable in any one test, and this was kept as nearly constant as possible by skilled control. The duration of each test was twenty minutes, but the engine was always kept in continuous operation for at least one hour, and often for several hours, before entrance upon a test.

The indicator readings were taken from a pair of Thompson instruments fresh from the hands of the makers. The indicator rig was built specially for the tests. It contained no geometric error; the error from lost motion was imperceptible; the length of cord involved was 8 in. for one indicator and 24 in. for the other. The indicator cocks were screwed directly into the cylinder ports. All gauges and thermometers used were calibrated especially for this work.

The friction of the engine when run empty was carefully determined. Because of the difficulty of making this determination with reliability two different indicators and six sets of springs were employed. The result of the whole is that the engine's friction is estimated at very close to 3.0 hp, or 4.3 per cent. of the engine's rating. The unusual lightness of this friction led to the repeated checking of its observation, as just noted, before accepting the result.

The results of the tests are shown in the accompanying table of data. The only explanation needed is perhaps in regard to the column of cylinder efficiency. These figures show the proportion of the heat available for work, under the conditions actually prevailing at the time of the test, which the engine succeeded in converting into work. That is, it is the percentage of the theoretically possible which the engine actually attained. In this column 100 per cent. would be the record, not of an engine which converted all of its heat supply into work, for no engine could imaginably do that, but of an ideally perfect steam engine operating under the conditions under which the engine operated. The results from the engine tested, figured in this way, are good standard ones.

In addition to the efficiency tests, a 36-hour endurance test was run under 80 lbs. of steam pressure and a load of 69.67 hp. During its imposition, two observations of efficiency were made. Their results

RESULTS OF ENGINE TESTS.

Test No.	Conditions of engine.	Actual pressure gauge.	Speed revolutions per minute.	Power. Observed h. p.	Power. Average h. p.	Water rate.	Cylinder Efficiency.	Thermodynamic Efficiency.
*14	Normal cut-off	125.50	321.6	125.90	123.5	27.6	55.6%	9.16%
*15	125 lbs.	124.00	302.6	121.10		27.5	56.1%	9.17%
3	Normal cut-off	79.30	304.1	74.10		30.6	60.9%	8.30%
4	80 lbs.	81.30	308.4	69.35		31.0	59.4%	8.20%
5	80 lbs.	76.10	296.1	75.82	71.55	31.6	60.4%	8.07%
100	80 lbs.	81.60	301.1	69.50		31.7	57.7%	8.04%
101	80 lbs.	81.50	299.3	69.00		31.9	57.8%	7.98%
8	25% under load	79.40	297.8	56.00	56.18	33.3	55.9%	7.65%
9	80 lbs.	80.30	297.7	56.35		33.0	56.1%	7.71%
6	50% under load	82.00	305.0	37.20	37.09	35.3	52.0%	7.21%
7	80 lbs.	81.80	304.3	36.97		35.5	51.8%	7.17%
10	75% under load	81.50	306.1	16.39	16.65	52.3	35.3%	4.87%
11	80 lbs.	81.50	306.5	16.90		49.9	36.9%	5.10%
16	25% over load	81.60	304.0	89.30		33.1	55.3%	7.69%
17	80 lbs.	81.10	300.9	87.30	87.00	34.4	53.7%	7.41%
18	80 lbs.	79.00	298.9	84.40		34.6	54.1%	7.36%
12	Normal cut-off	81.90	312.2	88.85	87.64	27.8	66.2%	9.15%
13	Condensing	80.00	310.3	86.42		27.5	67.4%	9.27%

In the 36-hour test: Pressure, 82.78 lbs. gauge. Horse power, 69.67 (average). Friction of the engine when run empty: 3.0-hp, equal to 4.3% of rating.

*Tests Nos 14 and 15 run at 125 lbs. pressure (gauge).

are scheduled with the others as tests Nos. 100 and 101. As to the showing made by the engine under this endurance test, it can only be said that no fault or suggestion of fault developed itself. The engine ran smoothly and quietly, with cool bearings, throughout the test. When shut down it was apparently ready to start upon a second similar run with equal success.

As to the general design and construction of the engine, Profs. Reeves and Allen add that with all which could be seen, upon dismembering the engine both before and after the series of tests was run, they were favorably impressed, and that for simplicity, compactness, good distribution of metal and convenience of arrangement, the engine provoked favorable comment from all who saw it.

Exhibits at the Railway Telegraph Superintendents' Convention.

At the New Orleans convention last week of the Association of Railway Telegraph Superintendents, several exhibits were made.

Mr. W. S. Logue, manager of sales of the Edison Manufacturing Company, New York, explained the merits of the various Edison products used in railway telegraph service.

Mr. Avery P. Eckert, assistant treasurer of the Safety Insulated Wire & Cable Company, of New York, had a display of samples of this concern's wires and cables.

Mr. E. W. Vogel had a neat exhibit representing block signals, crossing signals, relays and various other pieces of apparatus used in railroad signal work. The Yetman telegraph transmitter was represented by the inventors, Mr. Charles E. Yetman and G. G. Conkling, manager of the New York office. These gentlemen had on exhibition several of their typewriter transmitters.

Mr. C. K. Jones, of Tuscumbia, Ala., inventor of the automatic telegraph circuit protector and signal machine, exhibited one of these instruments. The object of the device is to eliminate delays to trains

resulting from failure of operators to promptly answer calls on the wire.

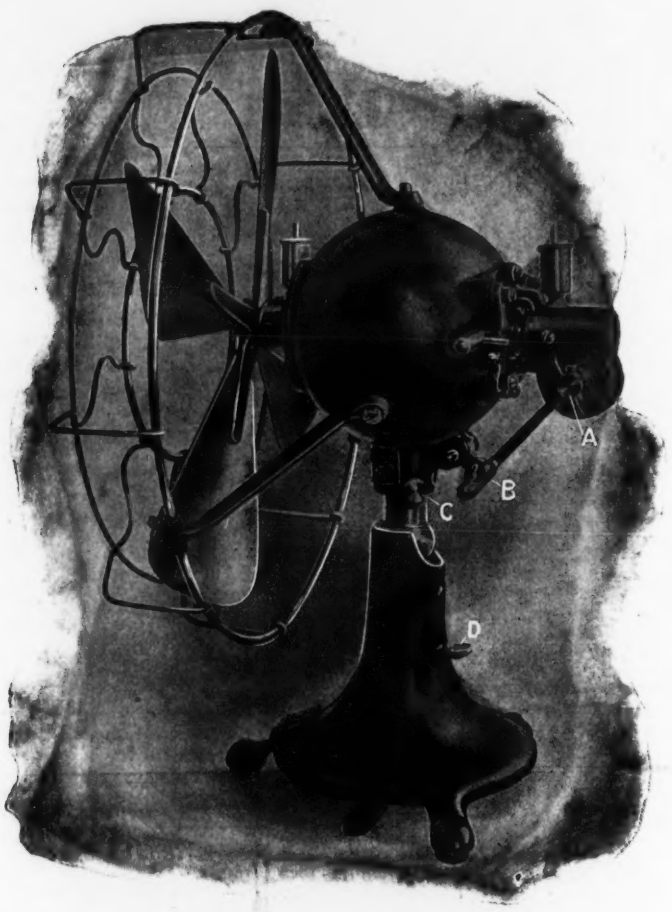
The American Telephone & Telegraph Company was represented by Mr. Percival W. Miller, special agent, F. E. Fowle, of the engineering department, and J. E. Gordon, of New York, besides several other gentlemen from different parts of the country. Mr. Miller had a composite telephone and telegraph circuit connected up in his parlor. In the operation of this circuit not the slightest interference could be detected while both telegraph and telephone messages were being transmitted at the same time.

The Western Electric Company, of Chicago, was represented by M. E. Launbranch.

Mr. C. E. Brown represented the Central Electric Company, of Chicago.

The Eck Universal Fan Motor.

The popularity of the idea involved in a fan motor which shall distribute its breeze instead of blowing constantly in one set direction



UNIVERSAL FAN MOTOR.

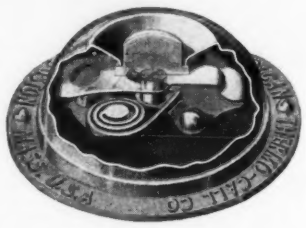
is shown in the ingenuity which is being brought to bear upon the solution of this not altogether easy problem. Our readers may all be assumed to be fairly familiar with the subject and will, therefore, recognize in the development of the device of the Eck Dynamo & Motor Works, of Belleville, N. J., a distinctly original method of periodical revolution, so that instead of being always pointed to the north, the fan distributes its breeze with equality and benefit to every other point of the compass. For this reason the Eck Hurricane fan in its new evolution is called the "Universal," and as will be seen from the cuts, the oscillatory motion is secured by a simple positive and direct drive. The trunnion arrangement for the desk type of fan allows a quick adjustment to be made in the motor stand, so that the general direction of the breeze can be regulated to suit any varying height of desk or shelf. By reference to the cut, it will be seen that in order to adjust the fan from a desk to an oscillating type, the screw, *A*, is loosened, the connecting rod at *B* is lifted and the screw, *A*, is moved from the center of the wheel and tightened a greater distance from the center, giving a corresponding wider arc of oscillation and vice versa. This involves loosening screw *C*, whereas to adjust from an oscillating to a desk fan, screw *C* is tightened and screw *A* is loosened, moving toward the center of the wheel until it stops and is tightened. In order to adjust for a trunnion or bracket fan, screw *D* is loosened, setting the head of the motor at the desired angle and is then tightened. The connecting rod at *B* is lifted and the motor head is turned to either side, as wanted, and screw *C* is tightened. All these arrangements can be made very simply and easily without screwdriver or wrench.

The fan blades are full-formed with a high propelling force, and are run at high speed with a minimum of noise. They are cut from heavy sheet brass and securely riveted to a strong cast spider or hub. The guards are rigid and durable, with the attaching braces cast with ribs, so that the fan can be picked up by the guard, the top brace being used as a handle. The motor is fitted for oiling purposes with an automatic grease cup, which gives adequate lubrication for easy and cool running the entire season. The insulation is excellent throughout, and the bearings are of phosphor bronze and self-aligning.

Thermo-Call Button.

The American Thermo-Call Company, of Boston, Mass., is placing on the market a device which discovers and reports fire automatically. It is very useful for hotels, factories, steamboats, public buildings and private dwellings. The American thermo-call button may be substituted for the push button now in general use, utilizing the same wires, etc., without requiring any alteration, thus making the call bell service doubly useful, i. e., combining regular call bell service and automatic fire protection. It is small and ornamental in design and is easily attached to the wall and connected as the ordinary push button. When once installed it needs no further attention either before or after an alarm has been given.

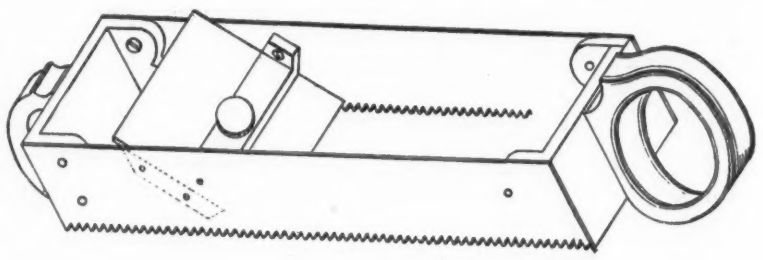
The button is set to give an alarm at 125° F. when not otherwise desired, but can be set at different degrees between zero and 400°, as may be desired, by the simple turn of an adjusting screw. It thus combines the ordinary push button now in general use and an automatic fire alarm, which, when the surrounding temperature reaches the degree at which it is set, indicates instantly the location of trouble, giving the occupants immediate notice of an incipient fire and making it possible for the fire to be extinguished without loss. The mechanism of the button is so simple and perfectly adjusted that it acts immediately. It should last a lifetime, requiring no special care and attention.



THERMO-CALL BUTTON.

Gain Cutting Saw.

An interesting improvement in gain cutting saws has just been placed on the market by the Kinsman Electric & Railway Supply Company, of 91 Liberty Street, New York City. It is shown herewith, and as will be noted, is a compact tool which will do the work

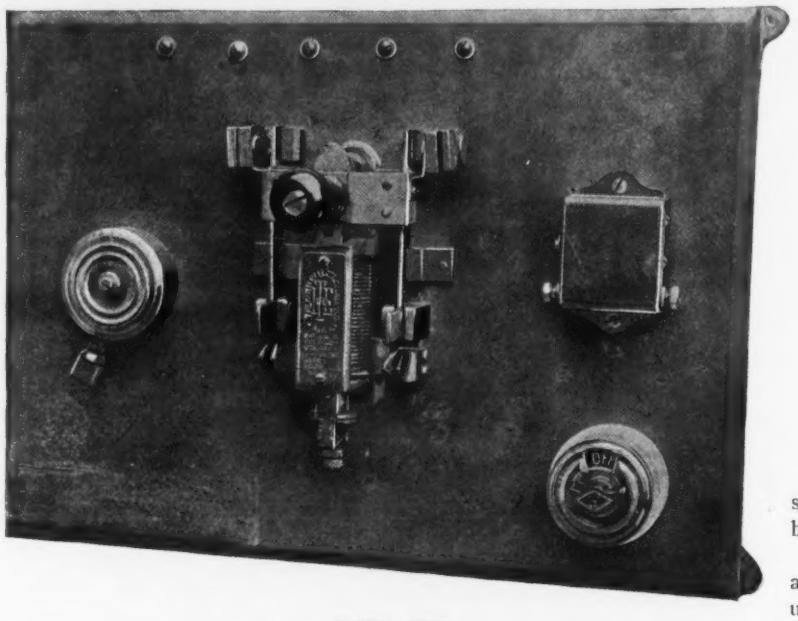


GAIN CUTTING SAW.

at present accomplished by three ordinary tools—the hammer, saw and chisel. It is so arranged that the saw teeth cut deeper than the chisel, allowing of a smooth movement. When it is desired to work quickly and push things along, the tool can be operated by two men; but in ordinary practice one man will handle it easily.

Motor Quick Stop Device.

The increase in the use of electric motors for power purposes has resulted in the introduction of a unique but an exceedingly practical device for a quick stop in the case of accident. For several years, the Consolidated Engine Stop Company, 100 Broadway, New York, has been installing an engine stop and speed limit system in hundreds of the biggest plants all over the country where steam is used for power. This latest addition to their speed limiting and quick stop-



MOTOR STOP.

ping devices is an electric motor stop, which places a motor, or a motor-driven machine, under absolute control from any part of the factory.

Snap switches of an improved dial pattern are placed at different points wherever desired, and one turn of the switch operates a separate battery system which throws the main switch at the board. A bell in the office or engine room, or any part of the plant desired, immediately rings a warning so that the person in charge may know that the power has been shut off. These switches are always available for immediate use, but are protected from meddlesome and unauthorized employees.

The switchboard is an attractive sheet of marble or slate carrying a testing apparatus as well as the main switch. The board itself can be used as a main switchboard or it can be placed in the office or other part of the plant and used only in emergencies. The apparatus can be tested from the switchboard to detect low battery power or short circuits. The system of wiring, which, patented, is so simple that chances of trouble with it are extremely remote. The motor stop can be connected to any size motor running under any voltage, and will stop a machine under load in two to five seconds. It can be applied to protect an entire line, or to a limited number of motors, or a single motor.

A New Ignition Dynamo.

A new dynamo for igniting gas and gasoline engines, shown in the accompanying illustrations, has just been placed upon the market by the Auto-Igniter Company, of 161 Washington Street, New York City. It is an inductor generator type of machine, and is remarkable for having absolutely no wearing parts; it also dispenses entirely with batteries and spark coils. The machine consists of an iron disc, with a portion of the iron cut away and the space filled with non-magnetic metal, revolving between the poles of a powerful compound magnet. The disc is fixed to the engine shaft, either on the end of the shaft or inside the hub of the fly-wheel, and the generator is fixed to the engine frame or to the floor. One of the magnet poles has two cylindrical projections and the active coil is wound upon one of these projections.

As the disc revolves the slot passes the polar projections once in every revolution and the change in flux produced thereby induces an e.m.f. in the coil. This e.m.f. is available to produce current for about 45° of every revolution, which is sufficient for engines requiring no more than one explosion for each revolution of the engine shaft. When more explosions are needed, as in some multicylinder engines, the disc is suitably cut away in two or three places. For igniting by mechanical device no spark coil is used, as the inductance of the active coil is sufficient to give a powerful spark at the interrupter. With 200 r.p.m. this spark is equal to that obtained with eight or more cells of Edison-Lalande battery and an ordinary

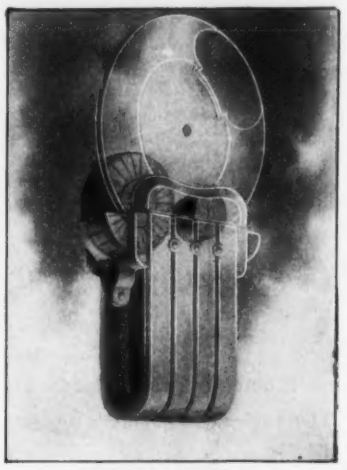


FIG. 1.—IGNITER.

spark coil. The machine is equally applicable for jump spark work by using an induction coil with a mechanical interrupter.

At the moment the slot leaves the polar projections with the active coil a high peak is produced in the e.m.f. This wave is utilized in starting the engine by so setting the inductor that the break of the ignition points occurs just as the iron is leaving the pole; by this means a sufficient current for igniting is produced by turning the engine over by hand or by other means. This is an important feature, as the engine can thus be started with this dynamo without the use of auxiliary starting batteries. By means of the double polar projections used in the design of this machine, the magnetic circuit of the permanent magnets remains closed in every

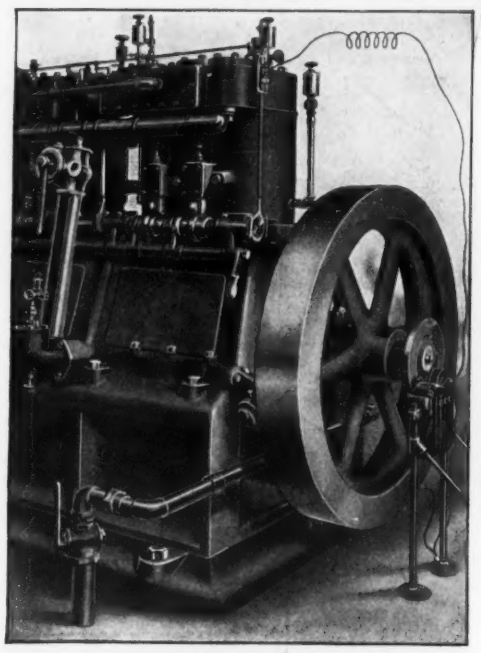


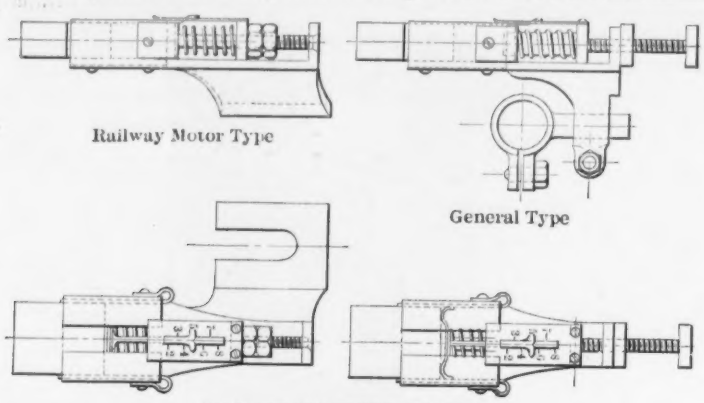
FIG. 2.—APPLICATION OF IGNITER TO VERTICAL ENGINE.

position of the inductor. Actual measurements made on magnets taken from machines in use for some time have shown that these magnets had actually increased in strength while in use. This is a valuable feature, as it secures the permanency of the magnets.

As there is neither a commutator nor brushes nor bearings to wear and require attention, the machine will last indefinitely and incur no expense whatsoever after its first cost. A number of these dynamos are already in use on single and multicylinder engines and are giving excellent satisfaction.

Registering Brush-Holder.

Two forms are shown in the accompanying illustrations of a type of registering brush-holder devised by C. H. Hines and made by the Lorain Steel Company, Johnstown, Pa. The brush-holder at all times records the exact pressure in pounds on the commutator of the brush, and enables all brushes to be set alike and maintained at equal pressure. The adjustment being double allows for maximum

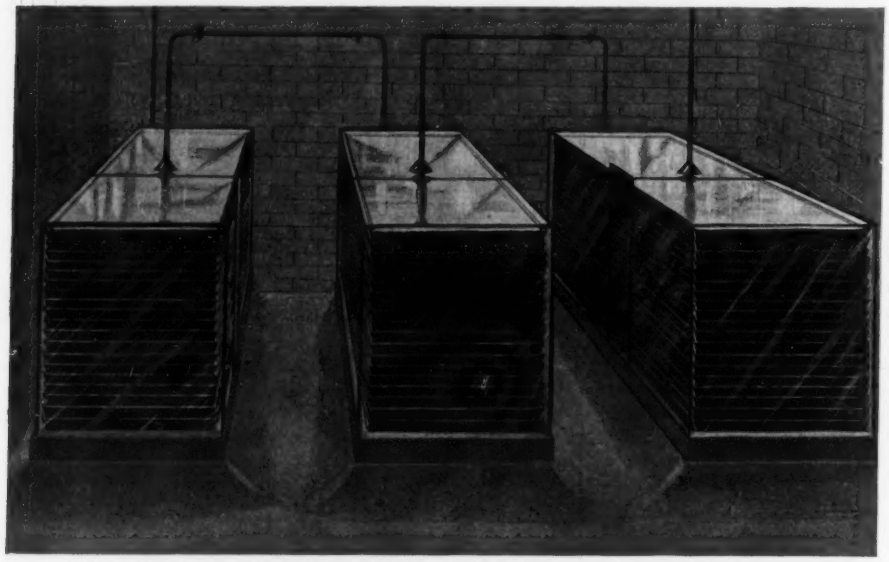


REGISTERING BRUSH-HOLDER.

wear of brush. The saving of commutators by use of this holder is claimed to be great. This type of brush is of especial value in laboratories, and in testing, when it is necessary to know the friction of brushes. The railway type enables the brushes to be set at uniform pressure and then locked so that all brushes will wear alike. The construction of the holder, as will be seen, is simple, enabling it to be offered cheaper than most of the older types.

Smith Storage Battery Plant in Boston.

An interesting installation of combined light and power has recently been made in the new Hotel Carlton at the corner of Boylston and Heminway Streets, Boston, one of the features of which is a



STORAGE BATTERY PLANT.

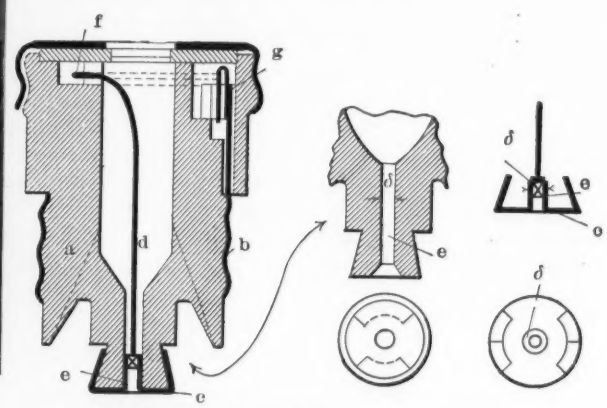
large installation of the Smith storage battery, as shown in the accompanying illustration, consisting of 57 trays and having a capacity of 800 ampere-hours at 114 volts. The Smith storage battery was brought out by the Smith Storage Battery Company, of Binghamton, N. Y., and is a radical departure from the beaten path in battery manufacture in style and form, embodying, however, no new principles, the battery elements being lead plates with dilute sulphuric acid as the electrolyte. Jars are dispensed with altogether, the lead plates themselves holding the electrolyte. The gridded plates are formed into oblong trays, any number of which may be nested on top of each other, separators of perforated seats of hard rubber, or other suitable acid-proof material, keeping the trays from contact with each other. There is sufficient space between the trays to hold the electrolyte which is in contact with the bottom of the tray above it, and the inside of the one which holds it. The chemical action takes place between the upper side of one plate and the under side of the one above it.

In the preparation of the plates, the under side of each tray is chemically treated to reduce it to lead oxide, and the upper side reduced to peroxide of lead. This makes the upper side of each tray the positive and the under side the negative electrode of what in an ordinary battery would be a single cell. By adding another tray to the nest the potential is increased by two volts, since the trays are connected up in series. The upper side of the upper tray, and the under side of the bottom tray are plain and inactive. The voltage of any battery will, therefore, be two less than twice the number of trays; thus, a battery of eleven trays will give 20 volts. In ordinary work there is no connection between the plates of the battery, except the electrolyte. The negative terminal is connected to the top of the upper tray and the positive terminal to the top of the bottom tray. However, it is possible to obtain any combination of series-multiple or multiple-series connections by attaching terminals to as many trays as desired and cutting in or out additional trays as the service demands. The arrangement of trays obviates a trouble frequently met with in storage batteries; that is, the deposit in the bottom of the jars of active material which is liable to cause a short-circuit between the plates. In this battery the positive plate, the one from which such deposits usually come, is the upper side of the tray, and hence all particles which become free in this manner will lie where there is no danger of causing a short circuit.

Repairable Fuse Plug.

A patent has recently been granted to Frederick H. Krebs, of Copenhagen, Denmark, on a type of fuse plug which permits a blown fuse wire to be easily replaced. At present the whole plug when a fuse blows, is rendered useless and thrown away; this naturally is a great waste, as only a very small part of the plug is destroyed. The object of the invention is to render it possible to renew the fuse part instead of the entire plug.

In the accompanying illustration, *a* is the plug, of porcelain or other insulating material; *b* is a standard Edison screw thread for fitting the plug in the usual way, and *c* is a detachable plate with fastenings; *d* is the fuse wire and *e* a wire gauge to prevent the insertion of a heavier wire than that for which the plug is constructed; besides this security against a fuse plug being improperly wired, the plugs differ in height for different capacities; *f* is a horizontal channel to accommodate a fuse wire without making the plug of larger



REPAIRABLE FUSE PLUG.

size than the ordinary Edison fuse plug and also to provide for higher voltages; *g* is the upper fastening of the wire—here shown as an easily inserted and removable piece of bent plate between which the end of the fuse wire is laid, after which the plate is fastened between springs.

The fuse wires, with or without contact plate, are intended to be supplied separate in packages, say with 12 pieces in each, and marked with the number of ampere capacity.

Railway Telephone.

It is stated that the Delaware, Lackawanna & Western Railroad will equip its entire road with a telephone system as an aid in the operation of its trains.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered freely by brokers, and there was an easy tone, the closing rates being 3¾ a 4 per cent for 60 to 90 days, and 4 a 5 per cent. for 4, 5, 6 and 8 months. The stock market was dull and heavy with very limited outside participation and bearishness on the part of the professional interests. False reports concerning steel prices, together with the labor troubles and the uncertain position of cotton speculation apparently offset the influence of easier money, favorable crop news and further increases in railroad earnings. The United States Steel stocks were heavy, and the industrial list was generally lowered. The feature of the traction group was the further decline of Metropolitan securities due to the call which has just been made for a second payment of 25 per cent. on the stock. Both General Electric and Westinghouse common suffered notable declines, as will be noted below. Brooklyn Rapid Transit declined from 66⅜ to 63⅝, closing at 64, this being a net loss of 1 point. Metropolitan Street Railway fell to 129 and closed at 130⅝, a net loss of 1⅜ points. The highest price of General Electric was 193 and the lowest 185¼. It recovered some of the loss and closed at 187½, this representing a net loss of 6¼ points. Westinghouse common made a decline of 7 points, closing at 206; on the other hand, preferred made a gain of 5¼ points, remaining steady throughout the week, at 200¼. Western Union lost 1 point, closing at 84½. Following are the closing quotations of May 19:

NEW YORK.

	May 12.	May 19		May 12.	May 19
American Tel. & Cable	80	78	General Electric	190¼	185¼
American Tel. & Tel.	155	154	Hudson River Tel.	..	..
American Dist. Tel	30	30	Metropolitan St. Ry.	131	130
Brooklyn Rapid Transit	65⅝	64¼	N. E. Elec. Veh. Trns.	⅛	..
Commercial Cable	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	20	N. Y. E. V. T. Co.	7	7
Electric Boat pfd	41	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel.	85¼	84
Electric Vehicle	11	9	Westinghouse com.	210	196
Electric Vehicle pfd	15⅝	15	Westinghouse pfd.	210	196

BOSTON.

	May 12.	May 19		May 12.	May 19
American Tel. & Tel	157	154½	Western Tel. & Tel. pfd.	96	95
Cumberland Telephone	..	..	Mexican Telephone	2	1⅞
Edison Elec. Illum.	..	..	New England Telephone	137⅛	137*
General Electric	192	..	Westinghouse	105	97
Western Tel. & Tel	19½	19	Westinghouse pfd.	104	98

PHILADELPHIA.

	May 12.	May 19		May 12.	May 19
American Railways	48⅛	..	Phila. Traction	96¾	96¾
Elec. Storage Battery	74½*	74*	Phila. Electric	7¾	6¾
Elec. Storage Battery pfd.	74½*	74*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	May 12.	May 19		May 12.	May 19
Central Union Tel	..	..	National Carbon pfd.	96	95
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	205	205	Union Traction	4	4⅛
Chicago Tel. Co	..	..	Union Traction pfd.	32	32
National Carbon	24⅛	24			

*Asked.

LONDON UNDERGROUND SCHEME.—The terms of the underwriting plan for the £7,000,000 5 per cent. profit-sharing notes of the Underground Electric Railway Company of London, already noted briefly in these pages were made public recently, and show some novel and interesting features, especially in the provision for the sharing of profits between the company and the subscribers to the notes. The syndicate circular states that the syndicate is to continue until November 1, 1904, unless the managers should dissolve it sooner. The managers also reserve the right to extend the syndicate further for six months from November 1, 1904. The managers are Speyer & Co., Speyer Brothers of London, and the Old Colony Trust Company of Boston. They are to receive as compensation 1 per cent. commission on the entire amount of £7,000,000 notes, or £70,000 ($350,000). This is to be paid by the London Underground Company, while the syndicate members are not to be charged anything by the managers. The syndicate's commission is to be 5 per cent. in cash, so that on the basis of a one-hundred-thousand-dollar subscription the actual payment which would have to be made would be only $95.000. All notes subscribed to by the syndicate are to be held subject to call, in other words, are to be pooled. The first subscription is due June 2. The notes are to be subscribed at 96. They will be payable to bearer in various denominations; £5,000,000 of the notes are to be taken by the shareholders of the company. The notes will be secured by a trust deed, under which will be deposited securities of the underlying properties to the amount of £10,056,000. Of this amount £7,750,000 will be stock of the tube companies. Under the trust deed this stock may be sold by the Underground Company, and if sold at above 95 per cent. the amount of the net profits above that price are to be divided between the company and the noteholders, the latter participating pro rata in each sale at the time of which their notes were still outstanding. In other words, if notes are retired, as they may be, before the sale of any of such stock, they will not share in the profits. The more notes retired before any such stock is sold the greater will be the profit to the underground company.

CHICAGO EDISON COMPANY.—Reports of the Commonwealth Electric and Chicago Edison Companies issued last week for their fiscal year ended March 31, 1903, show an extremely prosperous condition. Gross earnings of the Commonwealth Company increased 30.20 per cent. over the previous year and gross of the Edison Company increased 21.48 per cent. The greater interest attaches to the Commonwealth Electric, since it will absorb the business of the Chicago Edison Company when the latter's franchise expires some years hence. It is the Commonwealth, too, which is building a $6,000,000 plant in the southwestern portion of the city. While the increase in the gross earnings of the Commonwealth was as noted, operating expenses increased but a little over 25 per cent., and the net earnings increased 51.30 per cent. The earnings on the capital stock, all of which is controlled by the Edison Company, were 3.16 per cent. The Chicago Edison Company is erecting a building at 82 and 84 Market Street at a cost of $220,000. It will be eight stories high and will have a frontage of 55 ft. and a depth of 85 ft. The lower stories will be utilized as a sub-station, four 1,000-kw rotaries having been ordered for immediate installation. Provision will be made so that if desirable a storage battery can later be installed in the upper stories. As real estate is so very valuable in the downtown district, it is proposed to rent the rest of the building for manufacturing purposes.

ST. LOUIS TRANSIT BONDS.—A circular to stockholders of the St. Louis Transit Company announcing a meeting to be held on May 23 to vote upon a proposition to issue $20,000,000 in 5 per cent. bonds, had the effect of depressing Transit stock and the shares of the United Railways Company on the local stock exchange. There was surprise at the decline, as nothing new was contained in the circular, and the earnings of the Transit Company during the dedication days fully equaled the company's estimates. Official figures of the earnings of the Transit Company for the three days, April 30, May 1 and 2, were $81,369, which was paid by 1,027,580 revenue passengers. On April 30 the receipts were $32,055, which is the largest single day's receipts in the history of the company. It was generally believed that the announcement of the proposed bond issue, coupled with the favorable dedication report, would tend to advance the price of the securities. The bond issue is a refunding plan, and will result in a substantial saving in interest. The opinion prevails that the bears on the stock took advantage of the fact that the circular was not generally understood to put the market lower. The earnings of the Transit Company for the days of the dedication, April 30, May 1 and 2, were in excess of $81,000, as against about $51,000 for the same period in 1902. These figures give an idea of the increased facilities necessary to handle the traffic during the World's Fair.

AMERICAN MARCONI COMPANY.—At a recent meeting of the board of directors of the Marconi Wireless Telegraph Company of America, Mr. W. H. Bentley was elected second vice-president and general manager of the company. The following is the list of officers and directors of the company: First vice-president, Guglielmo Marconi; second vice-president and general manager, W. H. Bentley; secretary and treasurer, John Bottomley. Directors—E. Rollins Morse, J. J. McCook, Spencer Trask, Guglielmo Marconi, Eugene H. Lewis, Cyrus S. Sedgwick, H. H. McClure, John D. Oppe, W. R. Betts, Samuel Insull, Loyal L. Smith, Robert Goodbody, J. W. Griggs and W. H. Bentley. The offices of the company have been removed from the Maritime Building to the Lord's Court Building, 27 William Street.

KINGS COUNTY ELECTRIC.—Application has been made to the New York Stock Exchange to list Kings County Electric Light & Power Company $650,000 additional capital stock.

NEW WESTINGHOUSE STOCK.—As was announced briefly in this department last week, the Westinghouse Electric and Manufacturing Company offers to stockholders $4,500,000 of new stock, par value $50, at $80 per share. The new stock is part of the issue authorized by the stockholders in 1901 when the capital stock was increased from $15,000,000 to $25,000,000. The new stock is to have the same rights and privileges as the assenting stock, now outstanding. In his circular to stockholders President Westinghouse says that the present prosperous condition of the company's business more than justifies the action of the board until the increase in the company's manufacturing facilities should place it in the strongest financial position. The growth of the company's business has greatly exceeded the expectations of its officers. The following statement is made of sales for the four fiscal years ending March 31:

March 31, 1903:	
Year ending March 31, 1900	$12,793,703
Year ending March 31, 1901	15,853,481
Year ending March 31, 1902	19,975,958
Year ending March 31, 1903	23,899,492

To meet the rapid increase in business, additions were made at Pittsburg, which raised the output capacity to the present average of $2,000,000 per month. In addition to the East Pittsburg factories, there are large ones at Newark, Cleveland and New York, and the plant of the Bryant Electric Company, at Bridgeport, Conn. Net earnings from the company's manufacturing operations for the year ending March 31, 1903, were $4,650,000. These earnings, after deductions for depreciations and other purposes, exceed 20 per cent upon the outstanding capital stock. Dividends have been paid at the rate of 7 per cent. per annum on the preferred stock since 1892 and on the assenting stock since August, 1901. It is proposed on July 1 next to make the dates for the payment of dividends on both classes of stock coincide by the payment of a proportionate dividend on the "assenting" shares so that all may share alike in the event of dividend payment at rates exceeding 7 per cent. per annum. The company holds stock in the British Westinghouse Electric and Manufacturing Company, which for the nine months ending April 30, 1903, had annual contracts aggregating $6,500,000. The company's offer of $4,500,000 stock to shareholders leaves in the treasury stock of $2,466,950 par value. The offer is open to holders of record at the close of business May 23 at the rate of one share of such new stock for every four shares of existing stock. Subscriptions must be made before 3 o'clock June 8, 1903, accompanied by a check for $30 for each share subscribed for. The balance of the subscription will be payable as follows: July 23, 1903, $25 per share; September 14, 1903, $25 per share. The second and third instalments may be discounted at the rate of 4 per cent. per annum at the time of subscription. Holders of the new stock will be entitled to participate in dividends declared for the quarter ending September 30 next. The new stock will be listed on the New York Stock Exchange.

SPRINGFIELD (ILL.) CONSOLIDATION.—The organization of the Springfield Railway and Light Company, of Springfield, Ill., has been completed by King, Hodenpyl & Co., of New York, and E. W. Clark & Co., of Philadelphia. The new company has taken over the Springfield Consolidated Railway Company, the Springfield Gas Company, the Springfield Electric Light and Power Company, the Capital Electric Company and the People's Hot Water Heating and Electric Company. Plans for a new power house are now being prepared and many improvements and economies are being introduced. The capitalization is as follows: Twenty-five-year 5 per cent. gold bonds, $3,000,000; stock, $3,000,000. The officers are: Anton G. Hodenpyl New York, president; C. M. Clark, Philadelphia, vice-president; G. L. Estabrook, Philadelphia, secretary and treasurer.

CHICAGO UNION TRACTION.—Judge Grosscup, of the United States Circuit Court, Chicago, has ordered Union Traction to improve its service at once. No detailed report has been submitted by Manager Roach. He said, by certain retrenchments, he could save $75,000 a year, and would submit a report. Judge Grosscup has granted the Union Traction receivers permission to borrow money to pay the West Chicago dividend due May 15 and interest on the floating indebtedness of the North and West Chicago companies, the rate not to exceed 6 per cent. Judge Grosscup further decided that the payment of the West Chicago dividend to the holders of stock not acquired by the Union Traction Company shall have the same force and effect as if paid to the receivers of said West Chicago as rental due and payable under lease.

FINANCING MARCONI COMPANY.—Eugene H. Lewis, Chairman of the Finance Committee of the Marconi Wireless Telegraph Company of America, has made public a statement to the effect that arrangements have been completed to provide the Marconi Company with working capital to the amount of not less than $250,000, and possibly $450,000. The statement says that the arrangements were concluded at the office of the Continental Trust Company, which acts as trustee under the various guarantee and other agreements. The plan includes a privilege to stockholders to exchange their shares of stock for certificates of deposit, of the par value of $5 each, which certificates of deposit will be placed upon the market in lieu of the shares of the company.

AMERICAN LIGHT AND TRACTION.—The relative figures of this company show as follows:

	1902.	1901	Changes.
December, net	$122,805	$93,908	Inc. $28,897
Dividend on preferred	42,864	36,689	Inc. 6,175
December surplus	$79,941	$57,219	Inc. $22,722
Six months net	$566,743	$402,628	Inc. $164,115
Dividend on preferred	257,184	220,134	Inc. 37,050
Six months' surplus	$309,559	$182,494	Inc. $127,065

Preferred stock authorized $25,000,000; issued $8,572,800. Common stock authorized $15,000,000; issued $4,479,600.

A LARGE MERGER IN OHIO.—A dispatch from Cincinnati says, "J. M. Hutton, who has returned from Columbus, says that it is proposed to consolidate the Cincinnati Gas & Electric Company and the Cincinnati Street Railway, and later to combine all public utilities of Cleveland and eventually to combine the principal companies of Cincinnati, Cleveland and Columbus under one management. People directly concerned here are very reticent and say as yet it is too early to speak of any local combination, though President Ernest, of C. N. & C. Light & Traction Company, which is closely identified with the North American Company, says he is not surprised at such a deal."

HAMILTON POWER BONDS.—The Hamilton Cataract Power, Light and Traction Company, Ltd., of Hamilton, Ont., with an authorized capital of $5,000,000, has just sold $600,000 first and refunding mortgage 5 per cent. gold bonds to N. W. Harris & Co., Chicago. The company is a consolidation of electric power and light plants, including three street railway systems operating in Hamilton and adjoining suburbs and cities. The new company now controls the entire electric light and power business and owns and operates sixty-three miles of street railway in Hamilton and neighboring towns, having a combined population of 70,000.

INDEPENDENT TELEPHONE EXTENSION.—A plan is on foot to raise $2,000,000 additional capital to execute certain schemes which are now being developed by the independent telephone interests in Cincinnati. The independents have begun the stringing of wires and will, according to officials, be in active operation by June 1. All of the small towns in Ohio, Indiana and Kentucky will be connected with their service. The material which the independent concern is using is of the highest class, indicating that the 10-year contracts entered into by the several corporations is to be rigidly enforced up to the end.

DIVIDENDS. The directors of the Kings County Electric Light and Power Company, have declared a quarterly dividend of 2 per cent., payable June 1. Books close May 22 and reopen June 1. This is an increase of ½ per cent over the previous payment. American Railways Company's directors have declared a dividend of 1½ per cent. (75 cents) a share, payable June 15 to stock of record May 29.

CLEVELAND LIGHTING BONDS.—Bids will be received until June 15 at 12 o'clock, for $1,180,000 4 per cent. bonds of the City of Cleveland, including $200,000 electric light and power works bonds, due June 1, 1925.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade, building and planting operations and growth have been affected more or less by weather and labor conditions. These drawbacks, however, are looked upon as merely temporary. Wholesale trade, which is usually quiet at this season, reflected the conditions above referred to, but optimistic views still rule as to the outlook. The possible exceptions may be in the case of cotton manufacturing and in building, where the cost of raw material or of operation has been attained to almost prohibitive height. Railroad operations are very profitable and have reached the highest point on record. Collections failed to show much improvement despite the easier tone of money. In iron and steel, pig iron is weaker. There is no sign of weakness, however, in finished products, but there is a feeling that heavy imports of foreign billets may shortly affect prices for that product at seaboard markets. Specifications for new work are coming forward rapidly, and the mills producing finished material are pushed to keep up with the demand. Copper showed a firmer tendency, in sympathy with the condition of European markets. There has been no change, however, as yet, in the ruling quotations, which remain steady at 14⅝ a 14¾c. for Lake; 14⅜ a 14⅝c. for electrolytic in ingots, cakes and wire bars; 14⅛ a 14⅜c. in cathodes and 14c. for casting stock. The business failures for the week ending May 14, as reported by *Bradstreets*, numbered 182 against 175 the week previous and 190 the corresponding week last year.

VOUGHT-BERGER TELEPHONE ORDERS.—Among recent visitors at the plant of the Vought-Berger Company, La Crosse, Wis., were F. E. Davidson, president, and A. C. Miller, secretary, of the Redwood County Rural Telephone Company, Redwood Falls, Minn., who left an order for one hundred bridging telephones and a number of series instruments and pendant telephones and an addition for their Morgan switchboard; Rev. J. C. Siegler, of Nodine, Minn., who ordered a switchboard and fifty bridging telephones for the new farmers' lines centering at Nodine; L. G. Saxvik, of Highlandville, Ia., who ordered a switchboard; D. P. Walter, of Luana, Ia., who gave an order for a switchboard at Postville, Ia.; A. A. Peterson, manager of the Steele County Telephone Company, who bought a toll board for Blooming Prairie, Minn.; G. W. Morgan, of Reedsburg, Wis., who ordered a switchboard for La Valle; Leo Pottratz, of Eitzen, Minn., who left an order for twenty-five bridging telephones; also Mr. Brooks, of the Twin City Telephone Company and the Consolidated Telephone and Telegraph Company. Among other switchboards and equipments recently sold are a 200 drop-board for the Grantsburg exchange of the Consolidated Telephone and Telegraph Company, of Minneapolis; an addition for the Le Sueur board at Le Sueur, Minn.; farmers' line from Decoria to Good Thunder, and also in Apple Creek, Ohio; and Colorado, Tex.; Shiocton, Wis.; Holliday, Mo.; Madison, Mo.; New Hartford, Mo.; Spring Grove, Minn.; Tomahawk, Wis.; Jasper, Mo.; Keystone, Iowa; Goss, Mo.; Somers, Ia.; Clutier, Ia.; Highlandville, Ia.; Decorah, Ia.; Jamison, Ia.; Tonkawa, Okla.; Persia, Ia.; Postville, Ia.; Blooming Prairie, Minn.; Le Sueur Center, Minn.; Lexington, Minn.; New Virginia, Ia.

HEATING AND VENTILATING A COTTON MILL.—The Hope Mills Manufacturing Company, of Hope Mills, N. C., has equipped its mills throughout with the "hot-blast" system of heating and ventilation. All steam-coils are concentrated in a heater in the basement, through which the air is drawn by a fan and distributed to the several rooms through galvanized iron piping and brick flues. The fan is driven by a direct-connected horizontal engine which exhausts into a section of the heater. The remainder of the heater is of such capacity that, using exhaust steam from the mill engines, the buildings can be heated to a temperature of 70 degres F. when the temperature is 10 degrees above zero out-of-doors. The finishing building and the weave shop each contain two stories, and in addition, provision has been made for furnishing enough heat to the first story of the storehouse to prevent the freezing of the automatic sprinkler apparatus for fire protection, while the second story is to be heated to 70 degrees F. The guarantees are based upon the use of fresh outside air, although when warming up in the morning the air may be drawn from the interior, thus saving a considerable amount of steam. Live steam at 90 lbs. pressure is to be used at night, but, as stated above, the pipe capacity of the heater is sufficient to permit the use of exhaust steam from the power-plant of the mill in the daytime. The entire equipment has been designed and installed by the B. F. Sturtevant Company, of Boston.

2,400-HP GAS POWER PLANT IN CEMENT WORKS.—The Iola Portland Cement Company has recently ordered from Westinghouse, Church, Kerr & Co. a 280-hp, three-cylinder vertical gas engine as an addition to the extensive power equipment of its cement plant at Iola, Kan. The company operates its plant upon natural gas fuel and is one of the largest users of gas power in the cement manufacturing field. The present equipment comprises twelve engines of the Westinghouse vertical three-cylinder and two-cylinder single-acting type, aggregating 2,100 hp. These engines operate various classes of machinery, such as rock crushers, rotary kilns, shafting and generators, for supplying light and incidental power throughout the works. With the additional engine the power plant will comprise six engines of 280 hp each, five 125 hy each and two small engines. The 125-hp engines are used for driving kilns and the 280-hp for the rotary crushers. The machinery is in general arranged in groups upon sections of counter shafting driven by a single engine either direct-connected or rope driven. In point of size the installation has few precedents and its successful operation under such severe conditions demonstrates the many advantages of gas power for industrial establishments of all kinds.

STORAGE BATTERIES FOR POWER PLANTS.—Among recent contracts for installations of the Chloride accumulator in railway service, the Electric Storage Battery Company, of Philadelphia, has closed two with the Portland Railroad Company, located at Yarmouth and Underwood Park, Me. The battery at Yarmouth consists of 216 cells having a capacity of 134 kw-hours, and is located midway from the power-house on the same branch. Contracts have been closed with the Seattle Electric Company, Seattle, Wash., for a battery of 288 cells having a capacity of 628 kw-hours ; the Waterville and Oakland Railway Company, Waterville, Me., for a battery of 220 cells with a capacity of 205 kw-hours; the Reading Power Company, at Reading, Pa., for a battery of 264 cells with a capacity of 740 kw-hours. The Portland and Brunswick Railway Company, at Brunswick, Me., has increased the capacity of its battery by the addition of plates, and the Camden Interstate Railway Company, has contracted for the third battery of Chloride accumulators on its system. This last one is to be located at Huntington, W. Va., and consists of 288 cells, having a capacity of 314 kw-hours.

THE EWING MERKLE ELECTRIC COMPANY, of St. Louis and Shreveport is having a large sale of dynamos and motors of the Commercial make, for which it is the general selling agent. Among the sales for complete plants reported by it for the past week are: Huie-Hodge Lumber Company, Hodge, La., 20 kw; Keith Lumber Company, Voth, Texas, 30 kw; Eagle Lumber Company, Eagle Mills, Ark., 40 kw; T. C. Reed, Cerro Gordo, Ills., 60 kw; Shreveport County Club, Shreveport, La., 6¼ kw; Wm. Cameron & Co., Saron, Tex., 30 kw; French Creek Lumber Co., Chidister, Ark., 6¼ kw; Val Ries & Co., Belleville, Ills., 25 hp. This company also reports the sale of a very large amount of supplies and equipment for telephone companies.

JOHNSON-KAHN APARTMENT HOUSE.—The apartment house now being built between Seventy-first and Seventy-second Streets, Riverside Drive, by the Johnson-Kahn Company, 500 Fifth Avenue, New York, is to be equipped with two automatic high-speed engines, of 125 hp each, and one of 100 hp capacity. The Payne Engineering Company, 141 Broadway, took the order. These engines are to be direct-connected to generators of C. & C. build. The larger engine will be coupled to 75-kw generators, while the other engine will be direct-connected to a generator of 60-kw capacity. The switchboard will be supplied by the C. & C. people. The boilers—three units of 150 hp each—will be built by the Titusville (Pa.) Iron Company. The wiring contract has not yet been let.

EQUIPMENT FOR APARTMENT HOUSES, ETC.—Percival R. Moses, consulting engineer, 35-37 Nassau Street, New York, is about to let contracts for the electrical equipment of a number of apartment houses and office buildings now under construction in New York. The Louis M. Jones Building, northeast corner of Broadway and Leonard Street—a 12-story office building—is to be equipped with two 14-in. x 14-in. simple, automatic, high-speed engines for direct-connection to generators of 80-kw capacity each. This outfit is intended for lighting purposes. The Westminster Hotel, East Sixteenth Street and Irving Place, which is being remodeled, is to have a 100-hp simple automatic high-speed engine, to be direct-connected to a 60-kw generator.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., makes the following important announcement: "The constantly increasing demand for Christensen air brakes and 'Ceco' electrical machinery has made a change of our organization necessary. To accomplish this result, the owners of the stock of this company have organized the National Electric Company, and the assets, good will, etc., of this company have been transferred to the National Electric Company; the purposes, ownership, management and control of the new company are identical with those of the old. We desire and solicit a continuance under our new name of the satisfactory relations which have heretofore existed between us and the trade."

BRITISH CARS, ETC., FOR WELLINGTON, N. Z.—British firms have been awarded the contracts for practically everything in the way of equipment, etc., for the Wellington, New Zealand, municipal electric traction system, through M. A. Cartney, McElroy & Co., Havemeyer Building. The British Electric Car Company will build the car bodies of twelve double-deckers, the same number of single deck and eight combination cars. The contract was placed in England because of better prices and more favorable deliveries having been offered than could be obtained on this side.

THE CHASE-SHAWMUT COMPANY, manufacturer of electrical specialties, 390 Atlantic Avenue, Boston, is now building, among others, theatre switchboards for the following houses: Conservatory of Music, Boston; New York Theatre, Hudson Theatre, New Amsterdam Theatre and New Amsterdam Roof Garden, the last four in New York. It is also at work on an order for twenty-eight switchboards for the United States Engineer's office, Portland, Maine.

J. HOLT GATES & CO., 1436 Monadnock Building, Chicago, have taken the agency of the Skinner Engine Company, of Erie, Pa. They are also acting as representatives of the Quincy Company, of Quincy, Ill., for large Williams vertical, cross compound engines. This firm is now in a position to erect complete steam and electric plants.

GENERAL ELECTRIC.—The General Electric Company will erect three new buildings and add largely to its Lynn, Mass., plant. The company has secured contracts for a complete arc lighting system at Shanghai, and for motors for the new railways at Kobe and Tokio, Japan.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company has secured a contract through C. R. Heap, 47 Victoria Street, London, S. W., who handles considerable quantities of American machinery, for a 50-hp series-parallel equipment to be utilized for operating a Hoe quadruple printing press in the plant of the *Birmingham Daily Post*. The Sherman House Hotel, Chicago, Ill., is to be equipped with a 100-kw C. & C. generator to be direct-connected to an engine built by the Ames Iron Works, Oswego, N. Y. This outht is intended for lighting purposes. Edward Hueber, electrical contractor of Hackettstown, N. J., has ordered a 20-kw dynamo for direct connection to a Nash gas engine for installation in the Rutherford Stuyvesant resident at Tranquility Farms. The Broadway Tabernacle Church is to be equipped with three C. & C. motors aggregating 50 hp. They will be used for driving Sturtevant blowers. The Rogers Locomotive Works, Paterson, N. J., are to be shipped a 50-hp, also a 75-hp motor. This will make the ninth order received from the same source during the last six months. The Paterson Electrical Supply Company secured these orders on behalf of the C. & C. people. An order has been taken from William J. Thompson, of Washington Park, N. J., for a 100-kw belted generator and a 40-hp motor. This equipment will be used for lighting and for operating various amusement plants at that New Jersey resort. The Bedstead & Bedding Company is to have a motor-generator set for reducing power from 500 volts to 230 volts. Eight motors of 75-kw capacity have also been ordered. The Martin's Creek (Pa.) Portland Cement Company has ordered a 175-kw belted generator and two 80-hp motors, also a 60-hp motor, switchboard, etc. The Metropolitan Printing Company, 222 West Twenty-sixth Street, New York, has just ordered eight motors of 6-hp capacity each, which will make a total of nearly 30 C. & C. machines ordered by that concern. The motors are for direct connection to printing presses. The Brooklyn Terminal plant of the Brooklyn Bridge is to put in a 50-kw generator for lighting use. The generator will be direct-connected to a Reeves engine. The McKeesport (Pa.) *Daily News* plant is to be equipped with a 25-hp series-parallel outfit for operating a Hoe press. The Metropolitan Life Bldg., 1 Madison Square, N. Y., is to be installed with nine motors, aggregating 150 hp. These machines will be used for driving Sturtevant blowers and Blackman exhausters. A 1,000-amp. booster of 125-kw capacity—the fourth order—is to be built by the C. & C. Company for the Brooklyn Edison plant.

CONVEYOR PLANT FOR SOUTH AFRICA.—The New Kleinfontein mines, South Africa, are to be equipped with an extensive conveyor plant, the contract for which has been secured by the Robins Conveying Belt Co., Park Row Bldg., New York, through Fraser & Chalmers, Limited, Johannesburg. The plant will be electrically operated. The New Kleinfontein will be the first South African mine of any size to be equipped throughout with conveying belts, although considerable Robins equipment is already in operation in the De Beers, Witwatersrand Deep, New Primrose, Robinson and Van Ryn mines; also in the Cassel and Natal Glencoe collieries, and in the Imperial cold storage plant. All the New Kleinfontein ore, from the time it is loaded into the headgear until the sands and waste rock are precipitated to the dump, will be manipulated entirely by Robins belts. All coal is to be unloaded from hopper-bottomed trucks into bins, below which will be a Robins conveyor which will take it aside to be crushed to about one-inch cubes, when it will be lifted vertically by means of an elevator to another belt traversing the boiler-house. This latter belt with its traveling tripper will distribute the coal into hoppers, from which it will be drawn into automatic stokers. The main belt to the dump will be carried on a steel trestle work, the upper end of which will be 120 feet above ground. All the conveyors will be driven by British motors—enclosed type, slow speed, back-geared—to be supplied by Dick, Kerr & Co. The motors are to be direct-connected to the driving pulley of each conveyor.

NEW YORK & JERSEY RAILROAD COMPANY.—J. G. White & Co., 29 Broadway, New York City, have been appointed consulting electrical engineers for the New York & Jersey Railroad Company, for which Mr. Charles M. Jacobs is chief engineer. Mr. Jacobs is also chief engineer for the proposed tunnels of the Pennsylvania Railroad Company under the Hudson River,, and was the chief engineer who supervised the construction of the East River gas tunnel. The work of J. G. White & Co., in connection with this appointment, will cover the electrical equipment of the company's tunnels under the Hudson River, and terminals, rolling stock and equipment, system of electrical conductors, signal and interlocking apparatus, electrical lighting of tunnels and terminals, conduits and cables for carrying electric current, and other details connected with the electrical equipment of the above company's system, which will also include the elevators, ventilation and heating of the terminals.

LIGHTING A CIRCUS.—The Ringling Brothers have arranged for the use of Nernst lamps to illuminate the pavilions of their circus, which has been in winter quarters at Baraboo, Wis,. and recently opened the present season in Terre Haute, Ind. In order to provide the proper current for running the Nernst lamps, the Ringling Brothers had to sacrifice three direct-current machines, which had been made for them according to special design, construction and weight, and intended to be used for running direct-current enclosed arc lamps. After seeing the Nernst lamp, however, they decided to cancel all orders for direct-current apparatus and have installed, instead, three alternating-current, 220-volt machines, the lamps being hurried forward by express in order to be in time for the opening performance.

INTERURBAN AT TOLEDO, OHIO.—The Toledo Interurban Construction Company at Toledo, Ohio, informs us that its road is making good progress, and that it has already purchased cars, rails, ties and overhead material. The cars are designed after those of the Lake Shore & Michigan Southern Railroad limited library type, and are finished in mahogany, oak, cherry, natural and antique finishes. They are equipped with four Westinghouse No. 76 motors mounted on Dorner's latest improved M. C. B. trucks and geared to a speed of 75 miles an hour. They are equipped also with Westinghouse automatic air brakes. The company asserts that these are the finest interurban cars ever built.

ABERDEEN (SCOTLAND) TROLLEYS.—At a recent meeting of the Tramways Committee of the Aberdeen Town Council, tenders were opened for twelve new cars to be used on the lines of the Suburban Tramways Company, Aberdeen, Scotland. The contract was given to the British Westinghouse Electric & Manufacturing Company, Limited, and included the British Electric Company's car bodies, Westinghouse equipment and Brill trucks, the total cost being approximately $36,000. These cars are expected to be in operation by the end of June, the equipment being identical in every respect with that already installed in the Aberdeen cars.

THE LUNKENHEIMER COMPANY, of Cincinnati, Ohio, manufacturer of brass and iron steam specialties, etc., has recently placed with the Nernst Lamp Company, of Pittsburg, a large additional order for Nernst lamps of various sizes. The Lunkenheimer plant is now illuminated throughout by this make of lamp, it having been found superior to others in its uniform quality of light, with all sizes of units, a feature that is impossible with a mixture of arc and incandescent lamps.

THE TOLEDO, BOWLING GREEN & SOUTHERN TRACTION COMPANY has recently purchased, from the Westinghouse Electric & Manufacturing Company a 250-kw rotary-converter, which will be used for supplying current to its lines. Power will be received in the form of alternating current from the Maumee Valley Electric Company, which is installing a 250-kw inverted Westinghouse rotary-converter for the purpose, together with three 100-kw raising transformers.

SOUTHERN ELECTRICAL COMBINE.—Three leading electrical firms in New Orleans have consolidated—the Safety Electric Company, the Newman-Spranley Electric Company and Stern & Marks. Though details of the consolidation have not yet been arranged at the time of writing, it is understood that the new concern will be known as the Safety Electric Company. Charles Weinberger, president of the Safety Electric Company, will be the chief executive of the company. Mr. Stern, of Stern & Marks, has been slated for manager.

RARITAN (N. J.) POWER PLANT.—The National Fire-Proofing Company, of Pittsburg, whose New York offices are in the Broadway-Maiden Lane Building, will shortly award contracts for the erection and equipment of a central power station for lighting and operating the company's plants located on the Raritan River, N. J. About $120,000 is to be expended.

MEXICAN LIGHTING PROJECT.—Contracts are pending for the construction and equipment of a lighting plant in the town of Jehuacan, Mexico, which place has a population of about 12,000, and is noted for its medicinal waters and baths. Mocente Sanchez and Ramon de la Fuente are primarily interested in the project.

BALL ENGINE ORDERS.—The Morreau Gas Fixture Company, of Cleveland, Ohio, is to be electrically equipped. The engine will be furnished by the Ball Engine Company, Erie, Pa., and will be direct-connected to Westinghouse generator. The Ball Engine Company has also been awarded a contract for 14 engines, amounting to 2,400 hp, for electrical purposes in sugar factories. The engines will all be direct-connected to Crocker-Wheeler generators.

ELECTRICAL EQUIPMENT FOR JERSEY CITY PLANT.—The A. B. See Elevator Company is about to let contracts for the electrical equipment of its new plant in Jersey City. W. S. Barstow, electrical engineer, Bowling Green Building, New York, is acting as expert in the matter.

CAR HEATERS.—Mr. C. S. Hawley, of the Consolidated Car Heating Company's New York office, has just closed a contract with the Philadelphia Rapid Transit Company for 515 cars.

General News.

THE TELEPHONE.

CRAWFORDVILLE, ARK.—The Crittenden County Telephone & Telegraph Company, of Crawfordville, has filed articles of incorporation, the capital stock being $2,000. The officers are W. Z. Bunn, president; C. L. Campbell, vice-president and general manager; Hugh Chambers, secretary and treasurer.

COLUMBUS, GA.—The Columbus Automatic Telephone Company has been organized with a capital stock of $1,000,000. The Southern Telephone Construction Company will build the system. John T. Norman, of Columbus, has been elected president of the new company. Conduits are being laid for underground wires.

ATLANTA, GA.—The American Telegraph and Telephone Company, of Atlanta, is a new concern which it is believed will build an extensive long-distance telephone system in Georgia. A. Ward Cobb, of Atlanta; M. W. Beck, of Griffin, and others are interested. The company will begin with a capital of $25,000, but asks for authority to increase to $500,000.

OWENSVILLE, IND.—The Number Eight Telephone Company has incorporated. The principal office will be at Owensville. Thos. J. Boren, L. F. Mauck and W. D. Johnson are directors.

TWELVE MILE, IND.—The Twelve Mile Telephone Company has filed articles of incorporation with a capital stock of $5,000. L. C. Miller, J. M. Deniston and Wm. Carson are directors.

WARREN, IND.—The Warren Telephone Company is to make improvements to its city lines and is installing a new switchboard with a capacity of 140 drops. This is made necessary to take care of the increasing business.

INDIANAPOLIS, IND.—The Fairview Telephone Company has incorporated with a capital stock of $1,600. The principal office will be located at Sugar Branch, Switzerland County. J. K. Cunningham, Wm. B. Pavey and Joseph Goodner are directors.

SHELBYVILLE, IND.—The girls employed by the Bell Telephone Company in this city as operators went out on a strike because the manager frosted the windows to prevent them from looking out. The business over the lines was at a standstill for several days.

FAIRBANKS, IND.—The Fairbanks Mutual Telephone Company has incorporated to construct lines within Sullivan County. The capital stock is $5,100, and the directors are Levi Drake, E. D. Carrithers, Addison Drake, John Johnson, J. V. Dex, George Fuller and Owen Kisner.

MADISON, IND.—The commissioners of Jefferson County have granted to Capt. William Kirk & Co., a franchise to erect telephone lines and exchanges all over the county, making outside connections. This is said to be a step toward extensive telephone development in this county.

HARTFORD CITY, IND.—The United Telephone Company has decided upon extensive improvements here and at Montpelier.

LAWRENCEBURG, IND.—The People's Telephone Association, of Indiana, has purchased the line of the Dearborn County Telephone Company. The People's Association will make extensive improvements in the lines and property.

INDIANAPOLIS, IND.—H. B. Gates, J. S. Schaf, E. I. Fisher, of this city, and George W. Beers, of Ft. Wayne, are seeking an independent telephone franchise in Cincinnati. The Indiana men think Cincinnati offers an attractive field for an independent telephone system since resident telephones that cost $24 a year in Indianapolis cost $72 in Cincinnati. Business telephones that bring $40 a year here are $125 there. The Indiana men are able to enlist capital and will invade Cincinnati with one million dollars behind their enterprise.

NASHVILLE, IND.—A little over a year ago a telephone exchange was established here by the Morgantown Telephone Company and fifty or more telephones were put in the residences and business houses. A few weeks ago a petition was forwarded to the company asking for free service to Columbus, a few miles distant, and upon refusal, the patrons ordered their telephones out. This will be done and Nashville will be, for the second time, without telephone service. The Bell Company will at once install a new exchange and give the citizens free service to Columbus.

EVANSVILLE, IND.—The stockholders of the Municipal Telephone Company of this city, held a meeting recently and elected James Lauer, president; R. K. Dunkerson, treasurer, and F. M. Petersheim, secretary. The company then employed F. E. Eversole as constructing engineer for the municipal plant. Mr. Eversole has just completed a plant at Dayton, Ohio, and it was for this reason the municipal company was able to secure his services. Preparation is being made for the hearing of the suit to oust the Cumberland Company the first week in June. The attorneys for the Cumberland Company asked Mayor Covert, chief of police Hencke, members of the board of works Albecker and Wonderlick, Councilmen Iglehart and McCutcheon and City Attorney Funkhouser, if each of them held stock in the municipal telephone company. They answered in the affirmative. The object of the inquiry is beyond conjecture since the city charter does not prevent a city official from holding stock in a corporation.

MUSCATINE, IA.—An ordinance has been introduced in the council requiring the placing of all telephone wires in this city under ground.

LE CLAIRE, IA.—The Le Claire Independent Telephone Company has been organized to take over the present system, which will be improved.

COUNCIL BLUFFS, IA.—The Pottawatomie County Mutual Telephone Company has been incorporated with a capital stock of $150,000. Among the directors is C. A. Beno.

THURMAN, IA.—The Fremont County Telephone Company has been organized with a capital stock of $12,000, by H. M. McCartney, C. R. Paul, O. E. McCartney, I. A. Loose, L. S. Amber and R. B. Leecka.

FRANKFORT, KY.—The Pleasant Grove, Bethell & Floyds Fork Telephone Company of Bullitt County has been incorporated with a capital stock of $150.

WEST PARIS, ME.—The Curtis Hill Paris Telephone Company, of West Paris, has been incorporated with a capital stock of $10,000. The promotors are W. H. Lurvey, C. A. Fickett, F. C. Buck, F. L. Wyman, S. C. Curtis, Woodstock; C. S. Dudley, O. G. Curtis, E. L. Porter, W. C. Stearns, J. S. Dudley, J. A. Bicknell, F. H. Packard, S. T. White, C. L. Curtis, John A. Ross, W. W. Dunham, A. J. Abbott, W. E. Curtis, C. W. Chase, Paris.

BLISSFIELD, MICH.—The Blissfield Telephone Company has increased its capital stock from $7,000 to $25,000.

NEWBERRY, MICH.—The Munising Telephone & Electric Company has been awarded the contract by the Michigan Telephone Company to establish a telephone exchange at Newberry.

NORVELL, MICH.—The Brooklyn and Wampler's Lake Telephone Company has filed articles of association, the capital stock being $250. The headquarters of the company will be at Norvell. The directors for the first year are Ed. Hoxsie, Harry A. Blum and Charles Dresser.

ELBOW LAKE, MINN.—The Grant County Telephone Company, of Elbow Lake, with a capital stock of $100,000, has been incorporated by William E. Sandeene, Linnieus V. Barnes, Henry Sampson and Edward J. Scofield.

ST. LOUIS, MO.—In the City Council a bill was recently introduced by Councilman Sheehan, providing for a subway system throughout the city. The ordinance grants the right to run underground electric or steam railways, pneumatic tube systems, telephone and telegraph wires, and anything else that can be put underground. The persons seeking the franchise are Eugene Devine, W. T. Coony and John C. Kinney.

LINCOLN, NEB.—The new independent telephone company in this city has purchased a site for its new exchange, which will cost from $12,000 to $15,000. The company claims to have already obtained 2,000 subscribers and expects to increase the number to 3,000.

SOUTH OMAHA, NEB.—The Interstate Independent Telephone Company will establish a system here. The Stromberg-Carlson Manufacturing Company, of Chicago, is interested in the new enterprise. Underground conduits will be laid throughout the business portion of the city. The company will start with 1,000 telephones and will provide for future growth to the extent of 2,000. The franchise of the new company was granted last Fall.

LITTLE FALLS, N. Y.—The Interstate Telephone Company's exchange in this place was destroyed by fire recently, entailing a loss of $10,000.

BLISS, N. Y.—A new telephone company has been incorporated here with a capital stock of $500. It will render local service and build farmers' lines.

PENN YAN, N. Y.—The Penn Yan Telephone Company has been incorporated with a capital of $50,000. Directors: B. G. Hubbell, Buffalo, and T. H. Chew and L. G. Hoskins, Geneva.

CATTARAUGUS, N. Y.—The Pioneer Telephone Company, of Cattaraugus, has been incorporated with a capital stock of $12,000, by Edward C. Isbell, Edward G. Dietrich and Ernest B. Houghton.

DURHAM, N. C.—The Interstate Telephone Company, of Durham, has contracted for a $12,500 switchboard to be installed by June 1.

ASHEVILLE, N. C.—It is announced that the American Telephone and Telegraph Company will build a long distance line from Morristown, Tenn., to Asheville, N. C., and thence to Spartanburg, S. C.

DILLONVALE, OHIO.—The Dillonvale Telephone Company has been incorporated with a capital stock of $10,000. Mr. W. H. Ward is one of the directors.

CINCINNATI, OHIO.—The independent telephone lines in Indiana, Ohio, and Kentucky will secure entrance into Cincinnati, exclusive of the Bell lines. Twelve distinct companies have signed a ten-year contract.

PHILADELPHIA, PA.—The Keystone State Telephone & Telegraph Company has been incorporated with a capital stock of $10,000. The officers are: Treasurer, C. E. Platt; directors: Rob't W. Finletter, James M. Ashcraft, F. V. Kurtz, C. E. Platt, Joseph C. Perry.

EL PASO, TEX.—All the telephone girls in El Paso are on a strike for higher wages, and the city is without service.

FORT WORTH, TEX.—The contract for the switchboard for the Fort Worth Telephone Company has been awarded to the American Electric Telephone Company, of Chicago. The board will have a capacity of 6,000 lines.

BEAUMONT, TEX.—The Beaumont Northeastern Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are J. M. Smith, of Beaumont; W. S. Bruce, of Kountz, and Tony Rulfs, of Nacogdoches.

COLORADO, TEX.—The Texas & Pacific Telephone Company, of this city, has purchased the line between Sweetwater and Robert Lee, in Coke County. This gives the company an additional 600 miles of line, which covers a very large part of West Texas. The Southwestern Telegraph & Telephone Company has purchased the line between Waterford and Abilene and is now stringing double copper wires the entire distance.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will extend its lines throughout the southwestern portion of Utah, following the general line of the proposed San Pedro, Los Angeles and Salt Lake Railway.

SEATTLE, WASH.—Articles of incorporation for the North American Telegraph and Cable Company to lay a submarine cable from Seattle to Alaska and Vladivostok, have been filed here. The capital stock is $5,000,000.

FORT ATKINSON, WIS.—The Jefferson County Telephone Company, of this place, has increased its capital stock from $8,000 to $15,000.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company, which was sold recently to Leander Choate, of Oshkosh, will be re-organized. New capital will be put into the enterprise and the plant will be improved and strengthened.

ONALASKA, WIS.—The La Crosse Gas & Electric Company proposes to extend its wires to this place.

WALWORTH, WIS.—The Walworth Telephone Exchange Company has increased its capital stock from $1,200 to $2,200.

ELECTRIC LIGHT AND POWER.

LITTLE ROCK, ARK.—Arthur Neill is about to petition the Council for a franchise for an electric light plant.

PARIS, ARK.—The Paris Electric Light & Power Company, of Paris, has been incorporated; capital, $6,000. August Bartsch, president; Ed. Bartsch, secretary.

CORONA, CAL.—Bids will probably be received Sept 1 for an electric light plant, to cost about $45,000. H. A. Wood is City Clerk.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company was organized in 1897 with 200,000 shares at $100. At present it has 180 miles of wire, operating 2,600 arc and 320,000 incandescent lights.

LOS ANGELES, CAL.—Representatives of the Spreckels Independent Electric Lighting Company, of San Francisco, are reported to be in Los Angeles for the purpose of purchasing a site for the erection of an electric power plant.

SAN FRANCISCO, CAL.—The San Luis Gas & Electric Company, of San Francisco, has been incorporated; capital, $200,000. W. F. Boardman, Wm. Thomas and Woodley B. Smith, of San Francisco, are among the directors.

LOS ANGELES, CAL.—The Monterey Electric Light & Development Company was absorbed last year by the Monterey Gas & Electric Company, which has also taken in the Monterey & Pacific Railway. The present management has spent some $200,000 in improvements.

DENVER, COLO.—The Denver Highlands Electric Company shows an increase in incandescent lighting, having 8000 16-cp lights.

SALIDA, COLO.—The Edison Electric Light Company has 15 miles of copper wire circuit, 50 2,000-cp and 25 enclosed arcs, and 3,000 16-cp incandescent lights.

TELLURIDE, COLO.—The Telluride Electric Light & Power Company purchases power from the Telluride Power Company for 27 2,000-cp arc lights and 2,500 incandescents.

ASPEN, COLO.—The Roaring Fork Electric Light & Power Company is running 24 electric motors at 22½ cents per hp-day. It also furnishes heating for underground mine stations.

SILVERTON, COLO.—The Silverton Electric Light & Power Company uses the General Electric system and has 30 5-amp. G. E. enclosed arc lights with 2,200 incandescents. We are indebted to the manager, Mr. J. Crawford, for this information.

IDAHO SPRINGS, COLO.—The Cascade Electric Company which buys its current from the United Light Company, of Georgetown, Colo., operates a 15-mile circuit at 10,000 volt and 8 miles at 2300 volts. There are 20 2000-cp arc lights and 2,400 incandescents.

RIDGEFIELD, CONN.—An electric light plant will probably be constructed here. Thos. E. Wing, 20 Nassau St., New York City, is reported interested in the matter.

UNIONVILLE, CONN.—The Union Electric Light & Power Company has $40,000 capital stock. It uses Nernst lamps, single glower, for street lighting, and has about 3,000 incandescents for other use. Five electric motors are employed, also.

NEW BRITAIN, CONN.—The Connecticut Railway & Lighting Company is stated to have awarded to the H. Wales Lines Company, of Meriden, the contract to erect power plants in New Britain, Waterbury and Meriden, for about $105,000. The construction of these plants is a part of the plan to utilize the motive power about to be generated at the water privileges along Housatonic River in Litchfield County by the New Milford Power Company.

MILFORD, DEL.—It was voted to issue $20,000 bonds for electric light and other improvements.

OCALA, FLA.—The city has a municipal plant with E. C. Bennell, superintendent. It has 35 1,200-cp arc and 1,800 16-cp incandescent lights. At present it needs a 200-kw alternating current generator direct connected to 250-hp engine and two 125-hp boilers.

CALHOUN, GA., has no electric lights, but the mayor, Mr. Millhouse, contemplates putting in a plant.

CARROLTON, GA.—The Carrollton Electric Company is at present installing a 125-hp high pressure boiler and contemplates the erection of an ice and cold storage building in connection with the present works.

ATLANTA, GA.—The Pope Electrical Company, of Atlanta, will erect a plant between College Park and East Point to supply these towns with light, a contract to this effect having been made.

FITZGERALD, GA.—The water and light plant is under the management of the city officials. It operates a General Electric system, has 10 miles of circuit, 28 arc lights and 1,000 16-cp incandescents. A new boiler, a dynamo and engine will be required later.

ASHLEY, ILL.—The citizens have voted to issue $5,000 electric light bonds.

MASON CITY, ILL.—The Mason City Electric Light plant needs a 75-kw, 125 cycle alternator.

VIRGINIA, ILL.—The Virginia Electric Light Company has increased the number of its lights to 2,000.

BLOOMINGTON, ILL.—The Union Gas & Electric Company has practically left the electric lighting field.

RAYMOND, ILL.—It is reported that this city will install a municipal electric light plant, to cost about $8,000.

NEW ATHENS, ILL.—We note an increase in electric lights in the New Athens Electric Light & Power Company.

HURON, ILL.—The Consolidated Gas & Electric Company, of Huron, has been incorporated with a capital stock of $25,000.

DECATUR, ILL.—It is stated that the Decatur Gas Company will expend about $20,000 in improving its plant this summer.

CHICAGO, ILL.—The Dearborn Lighting Company has increased the number of its lights, having now 45 arcs and 1,500 incandescents.

ARCOLA, ILL.—S. L. Woodworth is the owner of the electric light plant, which operates 40 direct arcs, one Ball arc and 2,000 16-cp incandescents.

BARRINGTON, ILL.—The Barrington Electric Light Company runs a 50-hp motor for pumping city water. The rate is 5 cents per thousand gallons.

GILLESPIE, ILL.—The Gillespie Light Company operates 14 2,000-cp arc lights and 400 16-cp incandescents. It also runs two motors at a flat rate.

MENDOTA, ILL.—The Mendota Light & Heat Company has $10,000 capital, operates one motor circuit, 25 2,000-cp arcs and 1,200 16-cp incandescent lights.

DE KALB, ILL.—The DeKalb-Sycamore Electric Company, organized in 1902, has $200,000 capital stock and $175,000 bonds. It operates 762 enclosed arc lights.

DIXON, ILL.—The Dixon Power & Lighting Company has $100,000 capital stock and $50,000 bonds. It has 55 miles of wire, 90 arc and 7,000 incandescent lights.

BEARDSTOWN, ILL.—The Beardstown Electric Light & Power Company notes a fair increase. It operates 100 arcs of 1,200-cp and 2,000 incandescent lights of 16-cp.

AURORA, ILL.—Plans have been completed for the power house of the Fox River Light, Heat & Power Company, which will cost with equipment about $100,000.

SPARTA, ILL.—The Sparta Gas & Electric Company, L. W. Barker, president, wants the following machinery, all second-hand; two 25 or 30-kw direct current belted dynamos; one 100-hp engine.

MORGAN PARK, ILL.—The electric light plant is owned and operated by the village. It has 53 arc lamps of 1,200-cp, but requires an entire new plant for street lighting, with capacity of 100 arcs.

HOOPESTON, ILL.—The Hoopeston Electric Light & Heating Company has 40 miles of circuit, 35 arc lights and 4,500 incandescents, and is showing a steady increase. Mr. C. J. Wakeman is manager.

CHADWICK, ILL.—This place has a municipal plant with $5,000 capital. C. M. Kingery is manager. It operates 400 lights, and has need of a second-hand boiler and engine—80-hp boiler and 60-hp engine.

MOUND CITY, ILL.—The Mound City Water, Light, Power, Heat & Mfg. Company, organized in 1900, with $60,000 capital stock and $50,000 bonds. It operates 26 2,000-cp and 25 1,200-cp arcs and 2,000 16-cp incandescent lights.

SHELBYVILLE, ILL.—The Shelbyville Water & Light Company has secured the city contract for ten years. The cost of arc lights will be $60 each; incandescent lights, $18 each. The company will expend $15,000 in improving its plant.

CENTRALIA, ILL.—The Merchants' Co-operative Lighting Company has been incorporated with a capital of $5,000. It is proposed to furnish electric light, heat and power. The incorporators are William B. Smith, J. V. Parkinson and William Benjamin.

PARK RIDGE, ILL.—Mr. M. Schiessle is the proprietor of the Park Ridge electric light plant. He reports a first-class opening for an electric railway from Jefferson Park, Lawrence to Northwood and Fox Lake, also from Lawrence to Crystal Lake through Park Ridge.

CARTERVILLE, ILL.—The electric light plant is the property of A. C. Hope & Sons and supplies five acres and from 700 to 800 incandescents. Considerable new machinery has just been installed. Mr. Hope thinks there is need of a foundry or machine shop, for which he could supply power.

PONTIAC, ILL.—The Pontiac Light & Water Company, organized in 1902, with $265,000 capital, operates 40 miles of circuit and has 150 arcs and 6,000 16-cp incandescent lamps. Also 36 motors at 6⅔ cents per kw-hour. The company pretty well covers the electrical field, except manufacturing supplies and apparatus.

OAK PARK, ILL.—The village of Harlem Water Works and Electric Light plant is under municipal ownership, being managed by a president and six trustees. The system is now being changed from direct to alternating and the old direct apparatus, with lamps, is for sale. The plant supplies 125 2,000-cp arc lights.

CHICAGO, ILL.—The Keenan & Hyland Mfg. Company will erect a large plant in this city at the corner of Campbell Ave. and Taylor Street, at an estimated cost of $150,000. The buildings will be electrically equipped and lighted. The plans are being prepared by Mr. D. E. Postle. The company manufactures bank, store, office and bar fixtures.

CANNELTON, IND.—The city has just bought the electric plant.

REDKEY, IND.—We learn that this place is in need of an electric lighting plant.

TELL CITY, IND.—The Tell City Electric Company has four arcs of 1,200-cp and 1,200 16-cp incandescents.

ANDERSON, IND.—The city electric light plant will be enlarged and improved at a probable cost of $75,000.

KENDALVILLE, IND.—This city shows an increase in incandescent lighting, having about 2,500, and 50 arc lamps.

KNOX, IND.—The Electric Light & Power Company has 46 arcs and 950 incandescent lights. It also supplies power for street cars.

ANGOLA, IND.—The National Mill, Water & Light Company shows an increase in lighting, having 52 arc and 3,000 incandescent lights.

LA GRANGE, IND.—The La Grange Electric Light Company operates 30 2,000-cp arc lights and about 2,200 8 and 16-cp incandescent lights.

RUSHVILLE, IND.—The electric light plant is owned by the city. It operates 54 2,000-cp arc lights and 1,700 16 to 60-cp incandescents.

SOUTH BEND, IND.—The South Bend & Elkhart Power Company is preparing to construct a transmission line from the Hen Island Dam to South Bend.

MT. VERNON, IND.—This plant is the property of W. Gonnerman & Co., who report an increase of incandescent lighting, the number of lamps now being 2,500.

FAIRMOUNT, IND.—Messrs. La Rue and Patterson operate an electric light plant which furnishes 52 arc lights and 2,200 16-cp incandescent lights. They require supplies for an increase of 100-hp.

BRISTOL, IND.—Attorney Jas. DuShane, of South Bend, representing the Bristol Power Company, is reported to be securing options along St. Joseph River. The company intends building a water power near Bristol.

MARTINSVILLE, IND.—The Martinsville Light, Heat, Power & Water Company informs us through Mr. C. Blank, that it has just acquired control of the electric light and gas plant and contemplates a general overhauling.

VINCENNES, IND.—We are indebted to Mr. Rothuck, manager of the City Electric Lighting Company for the following. This company organized in 1899; has a capital of $150,000, and operates 225 arc lights and 2,000 incandescents.

ROCKPORT, IND.—The Rockport Water Works Company, represented by A. H Kennedy, reports a fair prospect for an electric railway. The company operates five enclosed arc lamps and 1,200 incandescents. A fine brick station accommodates the plant as well as water works.

OSGOOD, IND.—The Osgood Light Company, organized in 1902, has $2,000 stock and $10,000 bonds. Mr. E. D. Freeman, president; C. A. Baylor, vice-president; O. R. Jenkins, secretary, and W. R. Glasgow, treasurer. We are indebted to the first-named gentleman for information kindly furnished. The company operates 28 G. I. arc lamps and 500 incandescents. The officers are now organizing a company for the manufacture of storage batteries, under the H. P. King patent.

VINCENNES, IND.—The Vincennes Electric Light & Power Company furnishes 4,000 incandescent lights and motor power at 10 cents per kw-hour for maximum demand for 30 hours per month, 5 cents per 1,000 kw-hours for any further consumption. The consumer agrees to pay the company, as a minimum charge, $2.50 each month for one horse power and less rated capacity of motor installation; $4 each month for two horse power and less rated capacity; and for each additional horse power and less (nominal rated capacity) $1.00 per month, no such charge of less than $2.50 per month to be made.

BELLEVUE, IA.—The Bellevue Electric Light plant, organized in 1896, cost $16,000. Z. J. Hauck is general manager.

SPIRIT LAKE, IA.—The Spirit Lake Light & Power plant requires a feed water heater of about 150-hp and some arc lamps.

PERRY, IA.—The Perry Electric Light, Power & Heat Company reports an increase in electric lighting.

DAVENPORT, IA.—The Davenport Gas & Electric Company has 200 miles of circuit, 480 2,000-cp arcs for street use and 100 incandescents.

EAGLE GROVE, IA.—The Eagle Grove Electric Company, which was organized 1894, is now a private enterprise, articles of incorporation having expired.

GUTHRIE CENTER, IA.—Prof. G. W. Bissell, of Ames, has been employed to prepare plans for an electric light plant for the Guthrie Center Electric Light Company.

DENISTON, IA.—The Deniston Electric Light & Power Company has 36 1,200-cp arc lights and 3,000 16-cp incandescents. It also runs one motor circuit at 10 cents per kw-hour.

ORANGE CITY, IA.—The Orange City Electric Light Company, capital stock $14,000, president, E. H. Casjens, will be in the market for one 50-kw alternator, 133 cycle, and one 60 to 70-hp engine.

JEFFERSON, IA.—We are informed by Mr. P. Gray, manager of the Jefferson Light, Heat, Power & Water Company that there is a probability of important changes in his company in the near future.

MANCHESTER, IA.—The electric light plant is the property of E. W. Hoag. It employs the Westinghouse system and operates five acres and 1,500 incandescent lights. A 100-hp Corliss condensing engne and boiler are to be put in in the near future.

WATERLOO, IA.—The Waterloo Gas & Electric Company, organized in 1901, has $345,000 capital stock, 150,000 bonds. G. McLean is president and A. Burt manager. It supplies 110 arc lights and 5,000 16-cp incandescents. The company also runs 10 electric motors at the following rates: Base rate.—Ten cents per 1,000 watt-hours. Reduced rate.—Thirty per cent. of the base rate. Turning point.—¼-hp, $2.00; ½-hp $4.00; 1-hp, $7.00. Each additional hp up to 10-hp, $4.00; each additional hp over 10-hp, $3.00. Elevator service, half of above rates. Minimum charge.—Half of the turning point.

EUREKA, KAN.—The Eureka Light & Power Company operates 18 arc and 3,000 incandescent lights. It needs one Corliss engine.

IOLA, KAN.—The Iola City Light & Water Works commenced operations in 1901. The light department has 78 arcs and 400 incandescent lights.

TOPEKA, KAN.—The Edison Electric Illuminating Company has 57 miles of mains and 20 miles of feeders. It has 600 enclosed arcs and 26,000 incandescent lights; 1,385-hp in motors at 2½ cents to 7½ cents per kw-hour. The company runs 30 cars on meter basis.

BEECHMONT, KY.—The Village Improvement Society is considering the construction of an electric light plant.

BARBOURSVILLE, KY.—The Barboursville Electric Light, Heat & Power Company has increased the number of electric lights to 560.

LEBANON, KY.—The Lebanon Light, Ice & Power Company reports an increase in incandescent lighting, having 1,000 16-cp lamps. There is a good opening for an electric railway to adjacent towns.

STANFORD, KY.—The Stanford Water, Light & Ice Company was organized in 1892 with $56,000 capital stock and bonds. W. G. Welch is president, G. L. Penny, secretary and treasurer. It has a Thomson-Houston plant, 9½ miles of circuit, 30 1,200-cp arc lights and 750 16-cp incandescents.

WATERVILLE, ME.—The Union Gas & Electric Company, R. J. Patterson, general manager, has six arc and 3,000 incandescent lights, and six motors, at flat rates of about $20 per hp per year.

NORWAY, ME.—The Oxford Light Company operates 30 1,200-cp arc lights and 3,000 16-cp incandescents. It runs motors of 200-hp at 5 cents per kw-hour and furnishes power for the N. & P. Street Railway.

WATERVILLE, ME.—The Waterville & Fairfield Railway & Light Company operates 105 1,200-cp arc lights and 1,200 16-cp incandescent lights. It runs 25 electric motors at 50 cents per hp per month and 2 cents per kw-hour; also electric cars at 1½ cents per kw-hour.

BANGOR, ME.—The Public Works Company which furnishes all the commercial lighting in Bangor has its power station at Yeazie, about five miles from the city. It was established in 1890, thus putting it among the earliest power transmission plants from water power. It also lights Old Town. The lighting service extends about 10 miles north and south of the station. We are indebted to Mr. J. W. Cartwright, secretary of the above for particulars.

ROCKVILLE, MD.—The electric light plant which was burnt out in 1901, has never been rebuilt.

WESTMINSTER, MD.—The Carroll County Electric Light & Power Company reports an increase in number of incandescent lights. The officers are G. M. Parke, president; C. C. Gorruch, vice-president; A. H. Huber, secretary and treasurer.

SALISBURY, MD.—We are indebted to Mr. F. Dalmas, manager of the Salisbury Light, Heat & Power Company for the following: The company, which was organized in 1901, has already increased the capacity of its plant by installing a new engine and switchboard. A return tubular boiler of 150-hp capacity and new turbines are to be added. It now furnishes 26 arc and 3,000 incandescent lights.

WARE, MASS.—The Ware Electric Company has a capital stock of $30,000 and operates 46 arc lights and 1,784 incandescent lights.

WEBSTER, MASS.—The Webster Electric Company shows an increase in lighting, having 66 series, 21 multiple arc, and 2,200 16-cp incandescent lamps.

FRAMINGHAM, MASS.—The Framingham Electric Company has 126 miles of copper wire circuit, and supplies 17 arcs and 6,000 incandescent lights.

GLOUCESTER, MASS.—The Gloucester Electric Company supplies 80 public arc lights and 12,000 incandescent lights, furnishing power also for street cars.

SOMERVILLE, MASS.—The Somerville Electric Light Company has $274,700 capital and $50,000 bonds. President, C. L. Edgar; treasurer and manager, F. E. Smith. It has 586 enclosed arc lamps and 23,000 16-cp incandescents.

ANDOVER, MASS.—The Andover Electric Company was formed in 1889 with $30,000 capital stock and $25,000 bonds. W. H. Coleman is treasurer. The company's machinery being out of use, it buys power from Lowell, Mass., the feeder being 9 miles long.

FITCHBURG, MASS.—The capital stock of the Fitchburg Gas & Electric Light Company is $275,000—$45,000 ten-year coupon notes. Having outgrown its old plant, the company has installed a new one of 1,500-hp on the General Electric system. It is running 40 motors, and has 320 2,000-cp arc lights and 12,000 16-cp incandescent lights.

HUDSON, MASS.—The light and power department of the Town of Hudson plant (municipal) is under the management of W. G. Lawrence. There are 25 2,000-cp arc lights and 6,000 16-cp incandescents. A 250-kw generator with cross-compound engine is to be put in; single-phase generators are to be replaced with three-phase, and motor business is to be taken up. A new sewer system is to be installed and all of the pumping is to be done by electric drive.

SPRINGFIELD, MASS.—The United Electric Light Company was organized in 1887 with $800,000 capital. The officers are R. W. Day, president; W. A. Lincoln, treasurer; W. A. Mulligan, manager. The company has 1,500,000 feet of overhead arc wires, 400,000 feet underground cables and 500,000 feet alternating overhead wires; 911 street lights, 600 commercial, 1,200-cp, and about 50,000 incandescent lights, averaging 16-cp. It runs about 100 motors, from 2 to 4 cents per kw-hour; has about 50 heaters and charges several automobiles at the rate of 5 cents per kw-hour.

ST. JOHNS, MICH.—This municipal plant operates 66 arc lights and about 2,500 incandescents.

GLADWIN, MICH.—The electric light plant is owned by Schulz & Prindle. It has a Westinghouse alternating system.

BELDING, MICH.—The City's Light Company has 2,000-cp arc lights and 2,000 16-cp incandescents. It also operates 6 motors at a flat rate.

ESCANABA, MICH.—Mr. C. E. Smith is manager of the Escanaba municipal lighting plants which furnish 75 arc lights of 1,200-cp, and 4,000 16-cp incandescent lights.

BAY CITY, MICH., has a municipal plant which furnishes 270 2,000-cp arc lights and about 700 16-cp lamps wired in. The city offers the promise of success for other electrical enterprises.

WEST BRANCH, MICH.—The Rifle River Electric Lighting Company has $20,000 capital. This is a co-partnership with W. W. Vaughan manager. Thirty 2,000-cp arc and 1,800 incandescent lights are in use.

JACKSON, MICH.—The Jackson & Battle Creek Power Company has been

incorporated, with a capital of $100,000, by J. H. Bootes, Chas. Zang and others, to furnish light and power in Jackson and Calhoun counties.

SHELBY, MICH.—The village has a municipal plant which provides for 20 1,200-cp arc and 1,400 16-cp incandescent lights. At present it operates a Westinghouse 80-hp engine, but will require heavier ones this year.

YPSILANTI, MICH.—The Washtenaw Light & Power Company, of Geddes, Mich., B. M. Delameter, president, was organized in 1902 with $200,000 capital, and $300,000 bonds. The circuit covers 210 miles. There are 350 arc lights and 23,000 incandescents, also 60 motors.

ATHENS, MICH.—The Athens Electrical Company, J. M. Standiford, superintendent, operates 24 arc and 1,200 incandescent lights. The company needs a new 60-kw alternator, and thinks there is a good opening for an electric railway from Battle Creek to Coldwater through Athens and Union City.

LUDINGTON, MICH.—The Stearns Lighting & Power Company was formed in 1901 with $50,000 capital. J. S. Stearns is president; R. L. Stearns, vice-president; U. T. Culver, secretary. It operates 49 enclosed arcs and 7,000 16-cp incandescent lights, having also 14 motors at 3½ to 2 cents per hp-hour.

FRANKFORT, MICH.—The plant of the Frankfort Electric Light Company is for sale. It was organized in 1891, and is owned by Mr. Thos. Kenny. It is operated on the Wood system; two dynamos, transformers of 25-hp, 18 miles of wire, 18 arc lights, 1,500 incandescents and three 200-hp Allis-Corliss boilers.

MARINE CITY, MICH.—The Marine City Roller Mill Company was established in 1888, and incorporated in 1903, with $15,000 capital. A. Arnold is president; A. A. Manion, vice-president; E. Arnold, secretary; R. Monn, treasurer. The company operates 15 arc and 2,500 incandescent lights, and small fan motors.

PORT HURON, MICH.—We are indebted to Mr. W. F. Davidson, secretary of the Port Huron Light & Power Company, for the following interesting item. The Port Huron Company succeeded to the properties and franchise of the Excelsior Electric Company on July 1, 1901. The property at that time consisted of a fire proof building 125 ft. x 138 ft. in size, operating two cross compound 500-hp engines and one tandem 1,200-hp compound engine, with 3-phase, 60 cycle generators; also three 100-kw, 500 volt direct current generators for power purposes, besides 3 Brush 150-light arc machines and 4 T-H 50-light series arc machines. It has a transmission line 12,000 volts, 3-phase, 60 cycle, operating a large factory district about three miles from its central station, known as South Park, where there are a great many manufacturing plants located employing about 1,000 men. Polyphase motors are used on the power circuits and all of the electric light is furnished by the company's central station. In October, 1902, the company made a contract with the General Electric Company for a Curtis 1,500-kw turbo-alternator and with the Alberger Company, of New York, for a surface condenser, including pumps and all the necessary apparatus. This company has erected an entire new fire proof building adjoining its present plant, in which will be installed the steam turbo-alternator, the condensing outfit, steam driven exciters, and the new switchboard for the entire plant, which will have a capacity of 5,000-hp.

WINNEBAGO CITY, MINN., has a municipal plant which operates 14 1200-cp arcs and 2,400 16-cp incandescent lights.

SPRING GROVE, MINN.—Bids will be received June 2 by F. E. Joerg, Village Recorder, for $5,500 electric light bonds.

JORDAN, MINN.—The Jordan Electric Light & Heating Company organized in 1902, has $15,000 capital. C. H. Casey is president and S. L. Sly, manager.

FOSSTON, MINN.—Bids will be received May 18 by the Common Council for furnishing and delivering a direct-connected and combined 125-hp simple non-condensing engine and generator. W. E. Black is Village Recorder.

WINONA, MINN.—The Winona Railway & Light Company in addition to its lighting—281 1,200-cp arcs and 10,000 16-cp incandescents—is running 100 motors 12 to 6 cents per kw-hour; does automobile charging and operates the street railway.

FARIBAULT, MINN.—The Polar Star Electric Company, organized in 1894, has $30,000 capital and has just purchased a water power four miles from this city which will be developed in the near future and operated in connection with the present water power, when the steam plant will be shut down. A 500 to 600-hp generator is to be installed. Motors are now being put in with an aggregate capacity of 44-hp.

CROOKSTON, MINN.—The Crookston Water Works Power & Light Company dates from 1885. Its capital is $175,000 and bonds $160,000. The company needs about one mile of vitrified clay ducts for underground work and 6,000 feet of stranded bare cable for feeders overhead, all of 500,000 circ. mils. It also reports the need of an electric railway to run from Grand Forks, N. D., through Cookston to a popular summer resort called Maple Lake, 25 miles east, for which a good opening offers.

DURANT, MISS., has a municipal plant with 29 arc lamps and 1,000 incandescents.

McCOMB, MISS.—The McComb Electric Light & Power plant, the property of J. J. White, has 56 arc lights and 3,000 incandescents. The boiler plant operates a saw mill in connection with its plant.

BOONEVILLE, MISS.—The Booneville Electric Light & Telephone Company owns only one arc light and 410 16-cp incandescents. It contemplates enlarging its plant and for that purpose needs one 60-hp boiler, one 60-hp engine and one 25-gallon steel tank.

DEER LODGE, MONT.—The Deer Lodge Electric Company furnishes 30 2,000-cp. arc lights and 3,000 16-cp incandescents.

HELENA, MONT.—The Helena Light & Traction Company owns the street railway and operates 245 425-watts enclosed alternating current arcs and 20,000 incandescent lights.

GREAT FALLS, MONT.—The citizens have voted to grant a 25-year franchise to John D. Ryan & Co. for an electric light plant and street railway, and City Council has passed the necessary ordinances for the same. C. W. Swearingen is City Engineer.

CLAYTON, MO.—The West St. Louis Water and Light Company has filed a first mortgage on its property in St. Louis County for $1,000,000, in favor of the Colonial Trust Company. The loan was effected in August, 1902, and is to run for 20 years at 5 per cent., payable in gold, semi-annually. The mortgage covers the property and franchises of the mortagager in St. Louis County and in towns of Kirkwood, Webster Groves and Ferguson.

ST. LOUIS, MO.—The Carondelet Electric Light Company has applied to the St. Louis County Court for a franchise to string wires along certain portions of the Lemay Ferry Road, south of St. Louis, in Carondelet Township. If the franchise is granted it will insure lighting facilities for every section of St. Louis County except Meramec Township, and farmers can gather their vegetables and cultivate their crops by electric lights, the same as their customers in St. Louis do other work, after the close of day.

LINCOLN, NEB.—Bids will be received May 25 by Beman C. Fox, City Treasurer, for $65,000 street lighting bonds.

WAYNE, NEB., has a municipal plant which cost $35,000. It has six arc and 2,800 incandescent lights. Motor rates are 10 cents per kw-hour.

KEARNEY, NEB.—The Northwestern Electric Heat & Power Company, under the management of L. E. Watson, furnishes 38 arc lamps and 3,200 incandescent lights. Twelve motors supply 500-volt service at from 10 cents to 6 cents per kw-hour.

BLAIR, NEB.—The Blair Electric Light & Power Company operates 13 1,200-cp arc lights and 2,000 16-cp incandescents. It runs a 1½-hp Wagner motor for which the charge is 10 cents per kw-hour.

ASHLAND, NEB.—The National Bank, of Ashland, owns and operates the electric light plant. It has five arc and 1,000 incandescent lights, and will require supplies, as a new turbine water wheel is to be put in this summer.

NEWPORT, N. H.—Mr. M. W. Tenney, superintendent of the Newport Electric Light Company informs us that there is an opening for an electric road in the town.

LACONIA, N. H.—The Laconia Electric Lighting Company has recently purchased a new Lombard water wheel governor and a 160-hp water wheel. J. F. Merrill is general manager.

WEST STEWARTSTOWN, N. H.—The W. F. Allen Electric Company operates 1,000 16-cp and 50 32-cp incandescent lights, and is beginning to introduce electric heating devices. The company intends extending its lines 2½ miles to Beecher Falls, Vt., and Riverside, N. H., in the near future. A good opening for any electrical enterprise is assured by ample water power. Current is furnished for lighting Colebrook, N. H.

ALAMAGORDO, N. M.—Mr. M. H. Fisher is the lessee and general manager of the Alamagordo electric light plant which furnishes 50 arc lights and 1,500 incandescents. Rates for motors are $2.50 and $5 per month. Mr. Fisher informs us that a complete equipment for a 100-kw plant is wanted for Tucumconi, N. M., including Corliss engine and alternator and tubular boiler.

LE ROY, N. Y.—The Leroy Hydraulic Electric Company operates 50 arc lights and 7,000 16-cp incandescents.

MEXICO, N. Y.—The Mexico Electric Company, organized in 1890 with $20,000 capital, shows an increase in electric lighting.

COBLESKILL, N. Y.—The Courter Electric Company has $15,000 capital and $8,000 bonds. Stanton Courter is president; D. C. Dow, treasurer.

GREENE, N. Y.--The village has just purchased the electric light plant but nothing has yet been settled in regard to future arrangements.

COOPERSTOWN, N. Y.—The Clinton Mills Power Company reports an increase in its lighting service having 70 arc lights and 4,700 incandescents.

EAST HAMPTON, N. Y.—The East Hampton Electric Light Company, which was formed in 1902 with $48,000 stock, has not yet installed its plant.

FRANKFORT, N. Y.—The Frankfort Electric Light plant (municipal) is now installing an entirely new equipment, including building and machinery.

GENESEO, N. Y.—The Geneseo Gas Light Company has a capital stock of $16,000 and $12,000 bonds. It has 46 2,000-cp arc lights and 700 incandescents.

RICHFIELD SPRINGS, N. Y.—The number of lights of the Richfield Springs Electric Light & Power Company shows a steady increase, there being now 2,500 incandescents.

CLINTON, N. Y.—Thos. F. McBride, of Clinton, has purchased the old grist mill and property adjacent at Millburn, near Clinton, with the intention of developing a power plant.

AUSABLE FORK, N. Y.—The Ausable Electric & Power Company was organized 1902. It has six arc and 1,225 incandescent lights. The company expects to enlarge its plant this year.

FORT PLAIN, N. Y.—The Fort Plain Gas & Electric Light, Heat & Power Company does a small business in electric motors and has 65 2,000-cp arc lights. Private houses have meters.

DUNKIRK, N. Y.—The Board of Water Commissioners has decided to put in a 300-kw generator and outfit for city lighting, to be used for lighting the outskirts of the city, not now covered by electric light.

NEW YORK, N. Y.—The Toluca Electric Light & Power Company has been incorporated in Brooklyn with a capital stock of $300,000. The incorporators are David H. Valentine, T. S. Williams and H. Seibert.

SAUGERTIES, N. Y.—The Ulster Electric Light, Heat and Power Company, of Saugerties, has been incorporated; capital, $30,000. Directors: William A. Hanna, Ada H. Eckert and Jennie G. Hanna, Saugerties.

ALBION, N. Y.—The Albion Power Company, which also operates the gas plant, has a capital of $200,000. There are 105 arc lights and about 7,000 incandescents of 16-cp. There is a fine opening for electric railway work.

DUNKIRK, N. Y.—The electric light plant is controlled by the Water Commissioners. M. J. O'Donnell being president. It operates 55 miles of circuit

and has 90 arc lights, 3,500 incandescents and runs 6 motors at 8 cents per kw-hour.

CORNING, N. Y.—The Corning Gas & Electric Company was organized in 1900 with $375,000 capital. It furnishes power to operate the street railway, has 30 miles of wire, 93 2,000-cp arc lights and 2,500 8 and 16-cp incandescents.

HOLLEY, N. Y.—The Holley Electric Company is a municipal plant of which R. O. Bronson is superintendent. The number of incandescent lights is 2,000 and capital stock and bonds amount to $15,000. The company contemplates buying a boiler this summer.

DEPOSIT, N. Y.—The Deposit Electric Company, which operates a General Electric alternating plant, has a capital stock of $100,000. J. M. Briggs is president; C. P. Knapp, treasurer; A. E. Lovejoy, secretary. It supplies at present about 2,000 incandescent and 30 arc lights.

AMITYVILLE, N. Y.—The president of the Amityville Electric Light & Power Company, Mr. E. W. Davis, sends us the following: The company, which was formed in 1892, has a capital of $25,000 and $15,000 bonds. It operates 15 miles of circuit and 5,000 incandescent lights of 16-cp.

GREENWICH, N. Y.—The Consolidated Electric Company, of Greenwich, has recently purchased the pole lines and machinery of the Washington Electric Light & Power Company of this place. The water power which the Washington Company proposes to develop, was sold to the American Wood Board Company.

SAYVILLE, N. Y.—The Sayville Electric Company, incorporated November, 1900, has a capital of $15,000. It operates a General Electric alternating plant, two dynamos, 50 transformers and has 11 miles of circuit with 2,000 incandescent lights. There is an opening for electric cars in Sayville. Mr. D. D. White is president of the Sayville Electric Company.

ROCHESTER, N. Y.—The Rochester Light & Power Company, capital stock $500,000 and bonds $500,000, has been organized the present year, with H. R. Wilson, president; J. C. Havemeyer, secretary, and J. G. Kaelber, general manager. The company has under consideration the erection of a big plant for arc and incandescent lighting, the plans for which are now being prepared.

LOCKPORT, N. Y.—The Lockport Gas & Electric Light Company, a unique one of its kind, uses three sources of power—steam, water and energy from Niagara, which can be operated interchangeably. With such unlimited supply the company prospers accordingly and has 260 2,000 arc lights and 3,014 incandescent lights. We are indebted to the courtesy of Mr. Slade the superintendent, for these particulars.

UTICA, N. Y.—The Utica Gas & Electric Company, organized in 1902, has a capital stock of $2,000,000 and bonds of $2,000. The officers are A. N. Brady, president; W. E. Lewis, vice-president; W. J. Cahill, secretary; G. Stack, treasurer; A. B. Johnson and M. J. Brayton, managers of the gas and electrical departments, respectively. The company operates 1,700 arc and 35,000 incandescent lights, besides supplying motors aggregating 3,500-hp and 3,000-hp to the street cars.

ROCHESTER, N. Y.—At a recent meeting of the stockholders of the Rochester Gas and Electric Company directors were elected as follows: George W. Archer, Frederick Cook, A. H. Harris, J. R. Judson, W. L. Cole, Rochester; William Runkle, Walter Johnson, New York; C. B. Judson, George C. Hollister, Granger A. Hollister, George A. Redman, Harry L. Brewster, John N. Beckley, Rochester. The officers re-elected are: President, George W. Archer; first vice-president, Charles B. Judson; scond vice-president, William Runkle; secretary and assistant-treasurer, J. R. Judson; treasurer, W. L. Cole; attorney, A. H. Harris.

MARION, N. C.—Col. Sinclair is stated to have secured a franchise for an electric light plant.

ELKINS, N. C.—The Elkin Light & Power Company has $3,000 capital stock and operates nine arc and 600 incandescent lights.

MT. AIRY, N. C.—The Mt. Airy Power Company, a municipal plant, is not yet installed, but water and lights will be available this year.

STATESVILLE, N. C.—The city electric light department has increased its output, having now 56 1,200-cp arc lights and 800 16-cp incandescent lights.

GASTONIA, N. C.—The Gastonia Municipal Electric & Water Works began operations in 1900 with $30,000 bonds. It is under the jurisdiction of the Director of Public Works. Ninety-nine arc and 99 incandescent lamps are in service.

GRAFTON, N. DAK.—The electric light plant of this city supplies current for electric heating. An institution under course of construction, will require about 400 lights, and another to be built in the summer will also require a number. Rubber covered wire will be used inside the buildings, and weatherproof on the lines.

NEW LONDON, OHIO, has a municipal plant on the General Electric system.

HUBBARD, OHIO.—The citizens have voted to issue $10,000 bonds for an electric light plant.

WESTERVILLE, OHIO.—The Westerville Electric Company requires some general supplies, such as wire, sockets, etc.

RICHWOOD, OHIO.—E. A. Schambs is the owner of the electric light plant which operates 32 arcs and 1,400 incandescent lights.

CRESTLINE, OHIO.—The Crestline Illuminating Company has $55,000 capital. It operates 75 1,200-cp arc lights and 2,000 incandescents.

NEW LEXINGTON, OHIO.—The New Lexington Electric Light & Power plant is managed by T. J. Smith and has 51 arc and 1,800 incandescent lights.

READING, OHIO.—The Board of Public Affairs manages the electric light plant and takes care of 50 2,000-cp arc lights and 2,000 16-cp incandescents.

SHREVE, OHIO.—The Shreve Electric Light & Power Company has $8,000 capital and operates 600 incandescent lights. It is in need of one 125-hp engine.

MONTPELIER, OHIO.—The Montpelier municipal plant operates 54 arc lamps and 2,300 incandescents. It reports that an electric railway is in contemplation.

SALEM, OHIO.—The Salem Electric Light & Power Company operate 200 arc lights and 2,300 incandescents, besides running eight motors and three electric cars on contract basis.

CINCINNATI, OHIO.—The stockholders of the Cincinnati Gas & Electric Company have voted to increase the capital stock by $2,000,000 for improvements and extensions.

CALEDONIA, OHIO.—The C. D. Resler Electric Light & Power Company was incorporated in 1902 with $5,000 capital. It runs two motors and has 16 arc lamps and 500 incandescents.

VAN WERT, OHIO.—The Gas, Electric Light & Power Company, organized in 1899 with $100,000 capital and $60,000 bonds, has about 73 street lights and 5,000 incandescents. J. M. C. Marble is president.

MARYSVILLE, OHIO.—The Marysville Light & Water Company runs 21 motors of 93-hp at rates from 4½ to 7 cents per kw-hour. It operates 48 2,000-cp open arc lights and 4,000 16-cp incandescents.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company, organized in 1902, has an authorized capital of $250,000. It furnishes 126 arc lights and about 7,000 incandescents; also runs two motors of 100-hp each.

CHILLICOTHE, OHIO.—The Chillicothe Electric Railway, Light & Power Company runs electric cars and motors; does electric heating and automobile charging and operates 216 1,200-cp arc lights and 10,000 incandescents.

COLUMBUS, OHIO.—The contract for the erection of a building for the municipal electric light plant has been awarded to D. W. McGrath, of Columbus, for $68,675. Bids for poles and wires are still under consideration.

TROY, OHIO.—The Troy Electric Works (municipal plant), organized in 1897, has $27,000 capital. L. A. Pool is superintendent. There are 94 1,200-cp arc lamps and 8,000 16-cp incandescent lights. Sixty motors are supplied with power at 6 cents per kw-hour.

DAYTON, OHIO.—The Dayton Electric Light Company operates 600 2,000-cp arcs and 30,000 16-cp incandescent lights. It charges a few electric automobiles and supplies power for electric motors aggregating 600-hp at 7½ cents per kw-hour.

MEDINA, OHIO.—The Medina Electric Light & Power Company was organized in 1897 and is a private concern, with A. G. Oatman as manager. To meet increasing business, the purchase of a 100-hp water tube boiler and a 60-80-hp engine, is contemplated.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company was organized in 1901. F. Duncan is superintendent. It employs Western Electric and Westinghouse apparatus; has 18 miles of circuits; 49 2,000-cp arcs and 900 incandescents.

NEW BREMEN, OHIO.—In 1896 this plant was purchased from the town, and now operates 35 enclosed arc lamps and 3,500 incandescents. The company proposes to rebuild the plant this summer, connecting up other towns and furnishing both light and power. F. H. Plaice is manager.

CLEVELAND, OHIO.—C. E. Phelps, Jr., of Baltimore, Md., is here for the purpose of advising with the city officials in regard to the establishment of a municipal electric light plant. He estimates the cost of establishing a municipal electric light plant for Cleveland at $400,000. An ordinance has been introduced in Council, providing for the issue of $200,000 bonds for the purpose of constructing an electric light and power station.

TORONTO, ONT.—The Toronto & Niagara Power Company is making satisfactory progress in erecting its power plant at Niagara Falls. The specifications for the plant are completed and call for five generators of 12,000-hp each, making 60,000-hp in all. The company expects to deliver electricity in Toronto in about two years.

OTTAWA, ONT.—It is stated that the directors of the Mexican Light & Power Company have decided that the company should, in addition to acquiring the properties of the City of Mexico Electric Light Company, owned by Siemens and Halske, secure the properties of the City of Mexico Electric Tramway Company, owned by Werner Beit & Company, of London, Eng. By securing these interests the Mexican Power Company will control the companies using the largest amount of electric power in the Mexican Republic.

HEPPNER, ORE.—A. M. Slocum will install an electric plant at his mill to utilize water power and transmit electric power to this city. The plant complete will cost $20,000.

ASHLAND, ORE.—The Siskiyou Electric Power & Light Company has purchased the plant and equipment of the Ashland Electric Power & Light Company. The new company will greatly increase the capacity of the present plant.

MANSFIELD, PA., shows an increase in lighting, having 2,500 16-cp incandescent lights.

KUTZTOWN, PA.—The Kutztown Electric Light & Power Company has not yet put in its plant.

MEADVILLE, PA.—The municipal plant here is under the supervision of Mr. H. Ellsworth, and operates 120 2,000-cp arc lights.

KITTANNING, PA.—The Kittanning Electric Light, Heat & Power Company has assigned to the Armstrong County Trust Company.

MILLVALE, PA.—The Millvale Water & Light Company has 64 1,000-cp arc lights, and thinks that an incandescent plant is needed.

SHIPPENBURG, PA.—The Shippenburg Electric Light, Heat & Power Company supplies 36 enclosed arcs and 1,600 incandescent lights.

POTTSTOWN, PA.—The Town Council has appointed a committee, with L. W. Z. Fillmen as chairman, to consider the construction of water works and an electric light plant.

CONSHOHOCKEN, PA.—The Conshohocken Electric Light & Power Company, W. M. Bell superintendent, is installing a new 150-kw 500 volt generator for motor circuits.

HAMBURG, PA.—The Hamburg Electric Light & Power Company was organized in 1892 with $17,500 capital stock. Westinghouse incandescent and Fort Wayne arc systems are installed. It operates 30 arc lights of 2,000-cp and 1,300 incandescents of 16-cp.

UPPER MERION TOWNSHIP, PA.—The Upper Merion Electric Light Company has been incorporated to furnish heat and light for Upper Merion Township; capital, $10,000. Directors: Edw. H. Wert, C. Ramond Fritcher and Herbert F. Harris, all of Harrisburg.

LANCASTER, PA.—It is stated that a syndicate of Philadelphia capitalists, consisting of Ervin Lyndall, John I. Kyle, and others, are about to apply to the State Department for charters for three companies to develop water power in Colerain, Providence and Conestoga Township.

EAGLES MERE, PA.—The Eagles Mere Light Company was organized in 1900 with $25,000 capital, (issued $12,250) and $25,000 bonds (issued $13,000). President, C. La Rue Munson; secretary-treasurer and general manager B. G. Welch. At present it furnishes 1,500 16-cp incandescent lights and will run one 40-hp motor for the Eagles Mere Water Company to drive pumps.

SHARON, PA.—The Shenango Valley Electric Light Company is owned by the Youngstown-Sharon Railway & Light Company, of Youngstown, Ohio. It operates 200 arc lights and 5,000 incandescent lights; 100 motors at rates of 6 to 2 cents per kw-hour and 40 miles of street railway charging by meter at the switchboard of main power house.

SENECA, S. C.—The Seneca Cotton Mills has a General Electric plant which furnishes 75 arcs (which light the mill) and about 50 incandescent lights. The mill is run with motors—four 100-hp, one 50-hp and one 30-hp. T. C. Duncan is president and treasurer; F. M. Jordan, secretary.

GEORGETOWN, S. C.—The present Georgetown Electric Company dates from 1901. Stock issued $25,000; bonds issued $31,000. Forty-six arc lights of 2,000-cp and 2,000 16-cp incandescents are in operation. The company also runs six motors and supplies current for electric irons. We are indebted to Mr. S. S. Ingman, the manager, for some interesting details of improvements just completed in every branch rendering the plant up-to-date in every respect.

RAPID CITY, S. DAK.—There is an increase in electric lighting by the Rapid City Electric & Gas Light Company.

STURGIS, S. DAK.—Mr. S. A. Oliver is the owner of the electric light plant which supplies 21 arc and 1,200 incandescent lights. Mr. Oliver expects to install a new boiler in the near future.

HURON, S. DAK.—The Electric Company, of which E. J. Bowen is owner and manager, kindly furnishes the following: A Corliss engine has been recently started, and the National machine has to be enlarged to meet rapidly increasing business. A new armature is required for it, besides other machinery, so as to practically duplicate the plant.

WATERTOWN, S. DAK.—The Kirlin-Gray Electric Company operates 60 1,200-cp arc lights and 4,000 16-cp incandescents. It has a few electric motors. The company favors us with very interesting notes of the rapidly growing town and its surroundings, making obvious the need of an electric railway along an already graded line. It would gladly co-operate with any others seeking to engage in such an undertaking. W. F. Gray is president; O. M. Kirlin, secretary and manager.

HENDERSON, TENN.—The Henderson Electric Light Company is in the market for one 125-hp automatic engine, one 75-kw alternator, switchboard instruments and transformers.

BRISTOL, TENN.—The Bristol Gas & Electric Company was re-organized Jan. 1, 1902. B. L. Dulaney is president; M. D. Chapman, secretary and treasurer. It now operates 50 1,200-cp arc and 3,000 16-cp incandescent lights.

CHATTANOOGA, TENN.—The entire plant of the Chattanooga Light & Power Company is being remodelled and will be equipped with four 500-kw Curtis steam turbines and three-phase alternators; four 300-kw rotary converters and four 300-kw static transformers; also a 30-panel switchboard. We are indebted to Mr. B. T. Burt, general manager of the company, for this information.

MEXIA, TEX.—The Mexia Light Company, H. O. Cravens, manager, is extending its plant.

NAVASOTA, TEX.—The Bridges & Holly Electric Light Company has increased the number of its lights to 1,600 incandescents.

TERRELL, TEX.—The Electric Light Company was organized in 1902, with $50,000 capital. M. A. Loy is president; M. W. Raley, vice-president, and S. E. Noble, secretary. It has 14 arc and 3,850 incandescent lights.

BEAUMONT, TEX.—The Beaumont Ice, Light & Refrigerating Company, J. C. Ward, president, has $300,000 capital, and operates 225 enclosed arcs and 25,000 incandescent lights. The meter rate for motors is 7 cents per kw-hour.

LLANO, TEX.—The Llano Milling and Manufacturing Company, which succeeded the Llano Water, Light & Power Company, February 1, 1903, has about 700 incandescent lights. It is putting in a 25-kw Wood direct current generator and a 10-ton ice plant.

MANCHESTER CENTRE, VT.—Mr. R. Colvin sold his electric plant to the Vail Light & Lumber Company.

RICHFORD, VT.—The Sweat-Comings Company has a capital of $50,000. C. A. Powell is president; H. C. Comings, treasurer.

BRADFORD, VT.—The Bradford Electric Lighting Company was organized in 1897 with $15,000 and has one arc light and 1,200 8, 16 and 32-cp incandescents.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light & Gas Company, A. Barnes, president, is contemplating the purchase of 2 100-kw step-up transformers.

ST. JOHNSBURY, VT.—The St. Johnsbury Electric Company has a capital of $75,000 and bonds $50,000. The company furnishes electric heating on a two-rate basis from 6 a. m. to 6 p. m. at 5 cents per kw-hour.

SPRINGFIELD, VT.—The Springfield Electric Company operates 50 arc and about 3,000 16-cp incandescent lamps. Motors of about 200-hp take power at from 1 to 3 cents, according to quantity and hours used. Ten cars are heated in winter by electric heaters on a flat rate basis.

ISLAND POND, VT.—The Island Pond Electric Company, established in 1896, was re-organized in 1902, with a capital stock of $75,000, and $40,000 bonds. The installation is not yet quite complete, but the company expects to supply about 5,000 incandescent lights, and hopes to take care of other electrical enterprises.

BURLINGTON, VT.—The Consolidated Electric Company, of this city, is sending to its customers a statement showing the cost of electric lights in Burlington and other places. The present price in Burlington for arc light all night and every night is $80 per lamp per year. The company is offering a reduction from that price on a new contract. Meter rates are 6½ to 10 cents per kw-hour, and lamp renewals are offered free.

ST. ALBANS, VT.—All arrangements for the development of the water power of the Vermont Power and Manufacturing Company, at Fairfax Falls, have been completed, and all the details of the merging of the St. Albans Electric Light & Power Company into the Vermont Company above named are also concluded. The National Gas & Construction Company, of Philadelphia, has the general contract for the development of the power.

CHATHAM, VA., has nothing in the way of an electric plant.

CHRISTIANSBURG, VA., has a municiapl electric light plant which furnishes 23 2,000-cp arc lights and 650 16 and 32-cp incandescents.

SALEM, VA., has a municipal plant which is under the management of T. R. Boon, and has 55 arc and 850 incandescent lights.

FRONT ROYAL, VA.—The Royal Light, Heat & Power Company is controlled by the Town Council. It operates about 88 16 and 32-cp incandescent lights.

WYTHEVILLE, VA.—A franchise for light and power is to be advertised and sold about the beginning of June. The Brown Electric Company is going out of business.

BLACKSBURG, VA.—The electric light department of the Virginia Polytechnic Institute was organized in 1891. Mr. C. Lee is superintendent. We are indebted to Prof. S. R. Pritchard who informs us that enlargement of the plant is sadly needed, but financial difficulties prevent.

RADFORD, VA.—The Radford Water Power Company operates the electric light plant and runs three cars also owned by the same company. It will install an electric power pump of about 1,200 gallons per hour capacity as an auxiliary to its present steam pumping plant, and suggests that with cheap power good openings for new enterprises are offered.

MARTINSVILLE, VA.—The Town Council will, according to press reports, receive bids until May 23 for a franchise to use the streets for poles, wires and other appliances for the transmission of electric power. The party to whom the franchise is granted is required to establish and operate an electric power plant of not less than 650-hp and an electric lighting plant, the price to be paid by the town for each 2,000 cp electric arc light being $75 per year.

CEDARBURG, WIS.—It is stated that bids are wanted for $11,000 electric light bonds. W. P. Jochem is Mayor.

SEATTLE, WASH.—The Seattle Gas & Electric Company has sold all its electric business.

BALLARD, WASH.—The City Council has passed a resolution leasing the municipal plant to the Kilbourne-Clark Company.

SPOKANE, WASH.—The Washington Water Power Company operates 1,100 arc lights and 48,000 incandescents; 2,000-hp in small motors, for which the maximum rate is 9 cents per kw-hour and 60 cars—the company owning the street railway.

GRAFTON, W. VA.—The Grafton Gas & Electric Light Company shows an increase to 2,500 incandescent lights.

CLINTON, WIS.—The Standard Electric Company has gone out of business.

OCONOMOWOC, WIS.—The lighting department of the City of Oconomowoc furnishes 46 2,000-cp open arc lamps and 3,000 16-cp incandescents.

MANITOWOC, WIS.—The Electric Light Company shows an increase in lighting, having now 100 200-cp arc lights and 10,000 16-cp incandescents.

LADYSMITH, WIS.—It is stated that the Ladysmith Light & Power Company contemplates constructing a dam across Flambeau River near Ladysmith.

ASHLAND, WIS.—The Ashland Light, Power & Street Railway Company runs six cars in addition to furnishing 140 1,200-cp arc lights and about 3,500 16-cp incandescents.

TWO RIVERS, WIS.—The Two Rivers Water & Light plant is a municipal undertaking, with A. Hudson, superintendent. It supplies 43 arc lights and 2,500 incandescents.

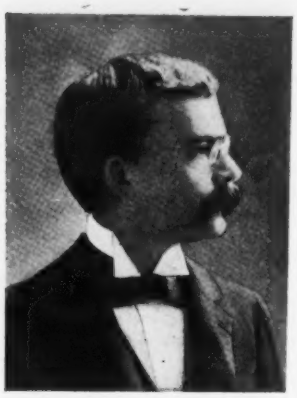
STOUGHTON, WIS.—The Stoughton Electric Light & Power Company does not report much change except in incandescent lighting, the number of lamps now being about 3,000.

SHEBOYGAN FALLS, WIS.—Charles S. Weisse & Company, proprietors of the electric light plant, operate 30 arc lights, 1,200 16 and 32-cp incandescent lamps, and 15 motors. We are informed that there is a good opening for an electric railway from Sheboygan to Plymouth.

BRODHEAD, WIS.—The Brodhead Electric Light Company, after many changes, was finally re-organized in February, 1903, and is now operated by F. W. Nuzum and G. M. Pierce as equal co-partners. It operates eight 1,200-cp enclosed arcs and 100 16-cp incandescent lights. A factory for machinery and supplies might locate here with advantage.

PERSONAL.

ELECTRICAL STAFF OF ST. LOUIS EXPOSITION.—Mr. Thos. A. Edison has accepted the position of Honorary Chief Consulting Electrician to the St. Louis Exposition and has written President Francis a cordial letter in praise and support of the enterprise. The other members of the strictly electrical staff are Prof. W. E. Goldsborough, Cloyd Marshall, P. E. Fansler and F. Welz, in order of rank. We present their portraits herewith, accompanied by a little biographical data. Prof. Winder Elwell Goldsborough was born in Baltimore, Maryland, October 10, 1871. In 1892 he graduated from Cornell University with the degree of M. E. A little later he took charge of the electrical work of the International Correspondence School of Scranton, Pa. In March, 1893, he accepted the appointment of Professor of Electrical Engineering at Arkansas University, Fayetteville, Ark. Just a year later he was called to Purdue University as Associate Professor of Electrical Engineering. In 1896 he was made full professor, and in 1897 was appointed Director of the Electrical Laboratory of the University. In January, 1902, Prof. Goldsborough accepted the position of Chief of the Department of Electricity of the Louisiana Purchase Exposition. He is a member of numerous engineering and scientific societies, among which may be mentioned the American Institute of Electrical Engineers, the Institution of Electrical Engineers of England and the Society for the Promotion of Engineering Education, and is a contributor to the proceedings of the societies and to the technical press. Mr. Cloyd Marshall, Superintendent of Electrical Machinery in the Department of Electricity, was born in Lafayette, Ind. After graduation from the School of Electrical Engineering of Purdue University in 1895, he was retained as an assistant in the electrical laboratory. Later he occupied the position of electrical editor of the *Street Railway Review*, of Chicago, and, during the period of this connection, from 1896 to 1898, he served as secretary of the Chicago Electrical Association. Mr. Marshall then accepted the position of designing and testing engineer for the Jenney Electric Mfg. Company, at the same time doing a considerable amount of experimental work for the Railway Materials Company, of Chicago. In 1901 he accepted the position of plant engineer, and, later, of engineer of the sales department of the C. W. Hunt Company, New York. He has occupied his present position since February, 1903. Percival E. Fansler, Chief Clerk, was born in Grand Rapids, Mich., in 1881. He graduated from the Chicago Manual Training School in 1898, and from the School of Electrical Engineering of Purdue University in 1901. During the following year he pursued a post-graduate course, making a special study of the electrical interurban problem. He conducted an important test on the interurban system of the Union Traction Company, of Indiana. which will be made the subject of papers to be presented at the general convention of the American Institute of Electrical Engineers at Niagara Falls, this June. Frank Welz, Technical Clerk, was born in Neu-Offingen, Germany, in 1875. He entered the Royal Bavarian "Kreisrealschule" at Munich in 1885, and graduated in 1891, after which he spent three years in the Royal Bavarian Industrielschule at Munich. From 1894 until his appointment on the staff of the Department of Electricity of the World's Fair, he was in the employ of the Allgemeine Elektricitäts Gesellschaft, advancing in six years from electrical engineer in the branch office at Munich to engineer in charge of the Cassel office. He was then sent to Bruxelles, where he had charge of electrical installations in Belgium and France until the Fall of 1902, when he came to the United States, assuming his present duties in January, 1903.



PROF. W. E. GOLDSBOROUGH.

CLOYD MARSHALL.

PERCIVAL E. FANSLER.

FRANK WELZ.

MR. GEO. M. COLE has resigned as manager of the Plattsburgh, N. Y. Traction Company. His successor is Mr. Albert E. Reynolds.

MR. P. A. B. WIDENER, the Philadelphia traction leader, has sailed for Europe, and says he has nothing to do with the London "tube" system.

MR. G. MARCONI is said to be in poor health as a result of his recent work, and has been ordered to the Riviera.

MR. C. T. YERKES is disposing of his Chicago trolley interests and other property in that city.

PROF. J. J. THOMSON has arrived in this country for the purpose of delivering the course of lectures at Yale University on the latest ideas in molecular physics, etc., as already noted in these pages.

MESSRS. S. G. VINSON, manager of the Phœnix Electric Company, of Mansfield, Ohio, and S. H. Suenerfauth, superintendent of the same company, have resigned to take effect as soon as their successors are appointed. The gentlemen contemplate going into a new line of business.

MR. CHAS. A. SCHIEREN, the eminent belt manufacturer, presided last week at the annual meeting of the Savings Bank Association of the State of New York in New York City, and was re-elected president for the ensuing year.

THE DUKE OF MARLBOROUGH, following the example of other progressive members of the British aristocracy, has ordered two electric elevators with push-button control from the Otis Elevator Company. These are to be installed in his city home, Blandford House, Curzon St., London.

MR. MARIANO SCHIAFFINO, the consulting engineer for the Guadalajara Tramways Company, is at present in the United States with a view to placing contracts for equipments, etc., for the electric traction system about to be built in that Mexican city. The initial length of the line will be somewhat over 30 miles.

MR. I. STERNEFELD, the manager of the electrical department of G. & O. Braniff, Mexico City, representing the Westinghouse interests in the Southern Republic, has left for home, after several weeks visit to the States. He is of charming personality and made a great many new friends while on this trip.

MR. W. B. REED, manager of an electric light plant at Managua, Nicaragua, also representative in that country of the Bullock Electric Company, is in Cincinnati endeavoring to form a company to build an electric railway at Managua. Mr. Reed claims to have secured an exclusive franchise from the Nicaraguan government for such a system.

MR. ARTHUR BERGTHEIL, of the British engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., which concern represents the Bullock Electric Company in Great Britain, is at present on a visit to the United States. He is now in the West, but is expected to return to New York early next week. While in this city he will stay at the Hotel Savoy.

MR. ERNEST THOMPSON, one of the managing directors of the well-known firm of Nalder Bros. & Thompson, Ltd., manufacturers of electrical instruments, London, was a visitor in New York last week. On account of a breakdown in health, he has been making a trip around the world for some months past. From New York Mr. Thompson proceeds to Montreal and thence home.

PROF. A. G. BELL.—Prof. Alexander Graham Bell has resigned the presidency of the National Geographical Society, and his resignation has been accepted by the Board of Governors to take effect on the election of his successor, which will not occur until next winter. Prof. Bell's reason for relinquishing the office is that all his time is employed and will be for more than a year to come in perfecting his new kite flying machine.

MR. GEORGE WESTINGHOUSE was a member of the party invited by Mr. G. W. Perkins, of the firm of J. P. Morgan & Co., to meet at luncheon last week Baron Von Rheinhaben, Prussian minister of Finance, now visiting this country. The luncheon was given at the Lawyers' Club.

MR. J. P. WINTRINGHAM, the stock broker, who has a very large acquaintance and connection in the electrical field has moved his offices to the Mills Building, 35 Wall Street.

MR. DUDLEY FARRAND.—It is stated that President Thomas N. McCarter, of the new Public Service Corporation, formed to operate the trolley, electric light and gas plants in Northern New Jersey, has appointed Dudley Farrand, of Newark, the general manager of the United Electric Company and general manager of all the electric light and power interests of the company, including the trolley plants. Mr. Farrand is well known as a successful manager in the light and power field.

MR. W. W. BRADFIELD. chief engineer of the Marconi Wireless Telegraph Company of America, is in Chicago where he is engaged in the equipment of a wireless station on the lake front. A connecting station is undergoing construction and equipment at Milwaukee, and both stations are expected to be completed and in running order within ten days, when wireless messages will be exchanged between the two cities. Plans are being laid for extensions of the Marconi system along the Atlantic coast, the great lakes and the Pacific coast.

MR. FRANK S. GANNON has been elected vice-president of the Interurban Street Railway Company, of New York. Mr. Gannon began his railroad training in 1868 as a telegraph operator. He has been successively train despatcher; master of transportation on the Long Island Railroad, President of the New Jersey Midland, general superintendent of the New York & Northern, general superintendent of the Staten Island Rapid Transit and third vice-president of the Southern Railway.

MR. E. H. ABADIE, of St. Louis, formerly well known in connection with the Wagner Electric interests there, has become general manager of the Elblight Company of America, and with Mr. Russell Spaulding will have an equal partnership in its control. Without giving up his business connections in St. Louis, Mr. Abadie will have headquarters also in New York City, and with Mr. Spaulding will now make an exhibit at the Chicago Electric Light Convention. It may be noted that Mr. Abadie was the agent through whom the Safety Insulated Wire & Cable Company secured their contract for over $200,000 for wires and cables at the St. Louis Exposition.

MR. MORITZ BOKER, of the German iron and steel firm of H. H. Boker & Company, is at present in the United States with Baron Von Rheinhaben, the Prussian Secretary of Finance, reference to whose visit has already been made in these columns. The Boker people act as German representatves for the St. Louis Car Company. The cars are shipped "knocked down" and are assembled at the Boker shops. They are used on the Berlin electric traction system. The German visitors left New York Monday for the West. They will return in a fortnight. While in New York they will be guests at the Hotel Netherlands.

MR. WM. C. BOYRER, of the engineering department of the New York Telephone Company, presented an interesting paper on "Some points to be observed in the installation of the common battery system in telephone exchanges," before the Brooklyn Engineers' Club, Thursday evening, May 14. Mr. Boyrer illustrated his remarks by charts and gave an interesting account of the difficulties encountered in changing from one system to another. After an informal discussion in which many of the intricate details of telephone operation were explained, light refreshments were served, and a very enjoyable evening brought to a close.

MR. F. S. PEARSON, of New York, vice-president of the Mexican Light & Power Co., who has just reached home from Europe, has advised a Montreal director that he has concluded arrangements with Messrs. Siemens & Halske, the Berlin bankers, for the acquisition of the Electric Light Company of the city of Mexico of which they are the owners. Messrs. Pearson and James Ross, who are so prominently associated with Canadian and other enterprises, some time ago obtained valuable water-power concessions from the government of Mexico and the existing plant in the city of Mexico was essential to the success of the undertaking. Details have already been given on the subject in these columns.

MARQUIS MARTIN MALONEY.—Cardinal Satolli recently applied to the Pope to confer a title of nobility on Martin Maloney, of Philadelphia, because of his large church offerings and his efforts to further Catholicism, especially in constructing a parochial church at Trenton, N. J. The Pontiff, after receiving satisfactory information from the Archhbishop of Philadelphia and the Bishop of Trenton, has issued a brief creating Mr. Maloney a Marquis. Mr. Maloney built a handsome church at Spring Lake, N. J., last year in memory of his daughter Catherine. The Maloneys have a large summer home at Spring Lake. Cardinal Satolli is an intimate personal friend of Mr. Maloney, who is well known in electrical circles from his prominent and active participation in electric light, tracton and storage battery enterprses, etc.

MR. THOMAS M. MOORE, chief of the Machinery Department of the St. Louis Exposition, has been visiting New York City for the purpose of arranging for space for New York exhibitors, accompanied by Lieut. Godfrey L. Carden, of the same department. Mr. Moore said that the space in Machinery Hall had been applied for many times over. Mr. Moore and Lieut. Carden came partly to receive Col. C. M. Watson, Secretary of the Royal British Commission. Mr. Moore is very much gratified over the prospects which the great power plant of the exposition offers as a drawing feature. This power plant will consist of about 40,000 horse power. Instead of utilizing a few simple type engines of local manufacture, the power plant will be made up of the latest forms of engines known to the world to-day, and for the most part these engines will come from Europe.

MR. WALTER B. SPELLMIRE.—The Bullock Electric Mfg. Company, of Cincinnati, Ohio, announces the appointment of Mr. Walter B. Spellmire as district manager of the Atlanta office of the company. He will assume his duties at once with headquarters in the Empire Building of that city. Mr. Spellmire has been with the Bullock Company some seven or eight years, during which period he filled the position of chief of the testing department; after which time he was sent to London and Paris by the company to look after some important installations at those places. After being abroad one year, he returned to the United States to fill the position of sales engineer in the New York office, from which position he has just been appointed district manager at Atlanta. From a knowledge of Mr. Spellmire's work with the Bullock Company, it is only fair to presume that he wll attain even greater success in his present position, in which he will have a very much broader field of operation.

GEN. W. A. GREELY, U. S. A., the head of the signal corps, started for Europe on May 13 in the American liner *Philadelphia*, to attend several conventions in London. The General said he expected to return about June 13. "I am going over chiefly to attend the convention of the International Telegraphers in London, on May 28. Every country, with the exception of the United States, is a member of the association. I do not know why the United States is not. I am going over there as a delegate, but without the power to vote. I will be permitted to get up and talk however. I am also to attend the convention of the International Colonial Institute, which is also to be held in London, two days before the telegraphers' meeting. The subject of wireless telegraphy will be most generally discussed. The German Emperor tried to get up an international conference on this important subject, but it came to nothing, as some countries would not join."

MR. W. G. WILGUS, the fifth vice-president of the New York Central Railroad Company, is the subject of an interesting interview in the *New York World*, in regard to the use of electricity on part of the system. This article includes also a neat thumb nail sketch of a quite striking personality. "His success has been due absolutely to his own worth, for it so happens that when he first applied to the New York Central Railroad for a job about eighteen years ago, he was turned down. He has been connected with this road for only ten years, but in that time he has risen by rapid stages from assistant engineer of a division to the fifth vice-presidency. Mr. Wilgus is a clean-cut man in every sense. His ideas are precise and at his tongue's end. He speaks frankly and tersely and leaves his listener in no doubt as to what he means. He is a man of medium build. Even a beard and glasses do not add any appearance of elderliness to his obvious youth. He is distinctly a young man, with the spirit, energy and enthusiasm of youth."

MR. JAMES BLAKE CAHOON has organized a Bureau of Expert Investigation and Construction to undertake the critical examination and valuation of properties and projected enterprises; the investigation of corporate charters, franchises, patents, etc., the conducting of tests, the preparation of plans and specifications for all classes of work, the supervision of contracts, and the organization and management of properties with a view to securing the highest degree of economy and the maximum of returns. Following is the personnel of the bureau, which has offices at 35 Nassau St., New York: Electrical and Mechanical Engineers, Horatio A. Foster, Frank B. Rae, GeorgeT. Hanchett and Thorburn Reid. Hydraulic Engineers, George W. Birdsall and Ira H. Carpenter. Civil and Mining Engineers, M. H. Alberger and Walter A. Calhoun. Chemist, Dr. William McMurtrie. Counsel, Cecil Campbell Higgins and Joseph T. Brown, Jr. Patents and Patent Laws, Howard P. Dennison and Thos. J. Johnston. Director, James Blake Cahoon.

LEGAL.

WESTERN UNION LOSES.—The Pennsylvania R. R. had had a contract with the Western Union Telegraph for 20 years, which gave the latter company the privilege of using wires and poles on the Pennsylvania lines and maintaining offices, etc. After 20 years it was provided that on six months' notice the Western Union must vacate the Pennslyvania lines. Such notice was given and it terminated last December. The Western Union began proceedings first of condemnation and filed a bill to enjoin the Pennsylvania from ousting the Western Union Company, alleging that under the act of congress with respect to post-roads the Western Union Company has a right to conduct the telegraph business on the Pennsylvania as they were a post-road under the law. Judge Buffington, in the United States circuit court at Pittsburg, refused the application of the Western Union for an injunction, and Decided all points in favor of the Pennsylvania. The United States court of appeals now affirms Judge Buffington's decision, and by this ruling a similar case in the United States court of New Jersey, which court granted an injunction against the railroad company, is decided adversely to the telegraph company. The Western Union has at once cut its wires, but the Postal is not yet ready for service.

OBITUARY.

MR. E. T. GILLILAND.—It is with deep regret we note the death on May 13, of Ezra T. Gilliland, the inventor of many of the improvements of the American Bell Telephone system. He died of Bright's disease at his home in Pelham Manor, a suburb of New York City. He began life as a telegraph operator, took up the telephone at the start, and soon distinguished himself as a meritorious inventor. He had a great deal to do with the perfection of the long distance transmitter. Mr. Gilliland was interested in the Gilliland Electrical Company, which has large factories in Adrian, Mich., and when he had perfected and patented his inventions he sent the models there to be duplicated for the market. He employed seven expert electricians in the laboratory at his home. He was also prominent in the affairs of Pelham Manor, and served as trustee and president of the village. Mr. Gilliland was born in Cuba, N. Y., 56 years ago, and lived most of his life in New York City. He was a member of the Reform, Manhattan, Colonial, Pelham Manor, New York Athletic and Columbia Yacht clubs. He leaves a widow, who was Miss Lillian Johnson, of Indianapolis.

Trade Notes.

DECORATIONS AT THE CHICAGO CONVENTION.—The Elblight Company will decorate the reception room at the Auditorium Hotel, at Chicago, on the occasion of the Electric Light Convention, and the Chicago Edison Company will furnish the current. A brilliant effect is promised.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., on account of the large number of orders recently secured in and around New York City, has established a branch office in the St. Paul Building, 220 Broadway. This will enable it to keep in closer touch with important interests in the city.

THE NERNST LAMP COMPANY is rapidly invading sections of the country heretofore uncovered. New York, Pennsylvania, the New England and Atlantic Coast States have agencies in every city of importance, while additions have been made in Salt Lake City, Denver, Lincoln, Neb., San Francisco, Los Angeles, Seattle and generally throughout the Mississippi and Western States.

THE CHRISTENSEN ENGINEERING COMPANY'S constantly growing business has made it necessary for the company to provide increased office facilities in Chicago; consequently a large office, fully equipped with every convenience, has just been opened in the Old Colony Building, where representatives of both the air brake and electrical sales departments will be pleased to welcome the customers and friends of the company. Mr. Chas. G. Burton, manager of the Chicago agency for the sale of the company's "Ceco" electrical machinery, has removed from the Merchants Loan & Trust Building into the new office. The air brake department is in charge of Mr. J. E. Eldred, Jr., who is well known in the electric railway field, having for a considerable time represented the company in the sale of air brake equipments.

AEOLICRAFT.—The Franklin Model Shop, 129 West Thirty-fourth Street, New York, has brought out an ingenious toy called the "Aeolicraft," which is a model yacht designed to sail on a tight wire stretched between two trees or other convenient points of support. The craft is suspended upon the wire by a truss and carrier frame shaped like an inverted triangle and having two pulleys in the upper corners with travel on the run wire. It sails along the wire just as a ship does in the water and when it reaches the end of the

course goes about automatically, sailing back to the starting point to repeat the evolution. Where space permits three posts can be set in an open lot and three wires strung to form and equilateral triangle. One of these wires will always be available to catch a good wind. This land yacht will afford much enjoyment as a pastime for young people with yachting proclivities, without the attending dangers of similar sport on the water. With two outfits, races can be sailed and the enjoyment thus greatly enhanced. A booklet describing and illustrating this interesting device has been issued, a copy of which can be had on application.

PROCTOR'S THEATRES.—The Summer plans for the F. F. Proctor circuit of theatres have been practically completed, and unless all present signs fail, the outlook is a brilliant one promising success for the management, steady employment for the large band of actors in Mr. Proctor's employ, and a gay season of highly entertaining shows for the public at large. Later on, there will be a revival of several of last season's biggest hits, and then there will be produced in quick succession half a dozen gay pieces never before seen in New York. All those productions will be as carefully made as though the season were at its height, for it is never Mr. Proctor's idea to curtail expenses, be the season early or late. At his Twenty-third Street Theatre, New York City, the plan of presenting all vaudeville shows will be continued throughout the Summer, the bills being made up with especial reference to the warm weather. At his One Hundred and Twenty-fifth Street house, the favorite stock company will continue its excellent work, strengthened immeasurably by the reappearance of Miss Adelaide Keim, who resumes her stage work after a much needed period of rest. The Twenty-third Street Theatre is now being fitted with cold storage pipes, which will insure cool temperature even on the hottest days. The show bills have been booked well ahead, and only the newest and best novelties will be shown this season. The Albany house has also undergone extensive improvement.

THE STANDARD VITRIFIED CONDUIT COMPANY is to have an exhibit of its conduit at the Auditorium Hotel, Chicago, Ill., during the National Electric Light Association Convention, in charge of Mr. B. S. Barnard, vice-president and secretary of the company. The new factories of this company at South River, N. J., are now in full operation, in addition to the old factories, and have a daily capacity of multiple and single duct conduit equal to the entire demands of the United States, and after July 1st, it can supply the world. The company has secured practically all of the orders for conduit in the New England States this season, and a greater part of the orders east of the Ohio River. Upwards of 1,000,000 feet of conduit was recently purchased through it for Salt Lake City, Utah, by the Stromberg-Carlson Company. This will be shipped from Western factories, which goes to show that the Standard Company is in a position to supply conduits in any part of the United States. It recently secured an order for one-half million feet for Memphis, Tenn., and the following corporations who are well known in the trade are using its product this season, in large quantities. Philadelphia Rapid Transit Co., Bell Telephone Co., Rapid Transit Subway Co., New York, Metropolitan Traction Co, New York, Brooklyn Rapid Transit Co., Brooklyn, N. Y., Boston Elevated Railway Co., Boston, Mass., Springfield St. Railway Co., Springfield, Mass., Mobile Light & Railway Co., Mobile, Ala., Consolidated Subway Co., New York, Niagara Falls Power Co., Niagara Falls, N. Y., and many other large corporations. It is likewise doing a great business in third rail insulators, so it would be well for engineers interested in conduit to secure the privilege to visit its factories, which would be interesting and instructive, in order to appreciate its exact position in the trade. The concern states that it is independent in every way. Its catalogue as issued to the trade is a work of art, acknowledged to be the finest book yet published on conduit and is strictly up-to-date, with many new suggestions, especially on manhole construction. Its stock is sold up for at least six months to come, small orders, however, could be filled promptly.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 12, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

727,567. ELECTRIC SWITCH; Vincent G. Apple, Dayton, O. App. filed June 16, 1902. A switch arranged to automatically indicate the relation of the dynamo and the batteries in the circuit in which they are contained.

727,568. DYNAMO ELECTRIC MACHINE; Vincent G. Apple, Dayton, O. App. filed Oct. 20, 1902. One head of the machine is hinged to the iron-clad field in such a way that when swung open the commutator is entirely exposed.

727,569. SHUNT WOUND SERIES ARC LAMP; Malcolm H. Baker, East Liberty, Pa. App. filed Mar. 11, 1902. A small auxiliary magnet is connected in series with the carbons to operate an iron core of sufficient weight to overcome the normal counter-balance for the upper carbon and thus maintain the carbons in contact before the starting of the lamp; this prevents an abnormal strain on the lamp which sometimes occurs at the instant of throwing on the current.

727,571. BRUSH HOLDER; Asa F. Bachelder, Schenectady, N. Y. App. filed Sept. 3, 1901. Details.

727,573. ELECTROMAGNETIC CLUTCH; Erl V. Beals, Boston, Mass. App. filed Oct. 8, 1900. The clutch has two coils of different strength actuating two different clutch members.

727,590. LAMP SOCKET; William H. Cole, Watertown, Mass. App. filed Aug. 19, 1902. Details.

727,596. ELECTRIC-ARC LAMP; Albert G. Davis, of Schenectady, N. Y. App. filed September 16, 1901.

727,601. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Fred T. Dow, of Schenectady, N. Y. App. filed July 19, 1900.

727,605. ANTI-HUNTING DEVICE FOR DYNAMO-ELECTRIC MACHINES; Hermann F. T. Erben, of Schenectady, N. Y. App. filed November 8, 1901.

727,606. METER; Walter C. Fish, Lynn, Mass. App. filed Sept. 24, 1902. To reduce the friction between the shaft and bearings, a symmetrical current-carrying coil is used in conjunction with an electro-magnet system for the purpose of reducing the pressure between the shaft and the bearings.

727,608. CONTACT DEVICE FOR TROLLEYS; Charles L. Fitch, Grand Rapids, Mich. App. filed July 1, 1902. A small roller or ball takes current from the under side of the wheel.

727,611. APPARATUS FOR MAINTAINING UNIFORM RESISTANCE IN ELECTRIC CIRCUITS; Frederick A. Gilbert, Brookline, and Emil O. Lundin, Beachmont, Mass. App. filed Nov. 22, 1897. An arc lamp having a series coil, a shunt coil composed of two conductors of different resistance and means for cutting out one of them at a determined temperature.

727,624. TIME LIMIT CIRCUIT CONTROLLER; Caryl D. Haskins, Schenectady, N. Y. App. filed July 30, 1901. A liquid reservoir having two chambers connected by a passage, is tilted to allow the liquid to flow from one chamber to the other, the liquid serving to close a circuit; adjustable weights are used to regulate the time intervals.

727,625. PERIODIC CIRCUIT CLOSER; Caryl D. Haskins, Schenectady, N. Y. App. filed Aug. 9, 1901. A modification of the preceding patent.

727,633. ELECTRIC BASE BALL REGISTER; John M. Humphreys, Trenton, Canada. App. filed June 21, 1902. The player's gloves and shoes are fitted with contacts which co-operate with contacts on the field to automatically show whether a player is "safe" or "put out."

727,634. TELEPHONE; Miller Reese Hutchison, of New York, N. Y. App. filed November 15, 1901. (See page 887.)

727,640. ELECTRIC METER; Elton J. King, Fort Wayne, Ind. App. filed Oct. 11, 1901. The object is the production of a meter of cheap construction which is capable of accurate results on alternating current circuits regardless of the power factor and which can be adapted to circuits of different frequencies without reconstruction.

727,641. MAGNETIC CLUTCH; Edgar Knowlton, Schenectady, N. Y. App. filed Oct. 3, 1902. The clutch members are drawn together by means independent of the magnetizing coil, the circuit of the latter being automatically closed when the members are in contact; this avoids sudden locking of the members.

727,649. TROLLEY CATCHER; Eugene Limauge, Brussels, Belgium. App. filed Dec. 3, 1902. Details.

727,662. INDUCTION MOTOR FOR VARIABLE SPEEDS; August Meuschel, Montreal, Canada. App. filed Oct. 5, 1901. Intermediate speeds are obtained by passing only a small portion of the useful armature current through a special armature resistance and full speed by armature circuits of very low resistance.

727,684. ELECTRIC MOTOR SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Oct. 31, 1900. A car is started with battery current and maintained at speed from the trolley, the battery being meantime charged.

727,685. COOLING DYNAMO ELECTRIC MACHINES; Edward D. Priest, Schenectady, N. Y. App. filed Nov. 2, 1900. The construction includes fan-blades in the inner parts of the machine which draw air through various passages in the armature and field frame.

727,686. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; Edward D. Priest, Schenectady, N. Y. App. filed Jan. 18, 1902. A modification of the preceding patent.

727,687. LIGHTNING ARRESTER; Henry Raymond, Schenectady, N. Y. App. filed July 22, 1899. The opposing surfaces of the arrester are made of large area by giving them a cup-shape and placing one within the other.

727,688. LIGHTNING ARRESTER; Henry E. Raymond, Schenectady, N. Y. App. filed July 22, 1899. The mass of the dischargers is reduced but they are made hollow and of large surface to easily conduct away the heat.

727,689. MAGNETIC CLUTCH; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 3, 1902. The clutch has two coils, one of which is weaker than the other and serves to bring the members together and create a certain amount of friction, after which the second coil is brought in to establish the lock.

727,690. ELECTRIC ARC LAMP; Edwin W. Rice, Jr., Schenectady, N. Y. App. filed Aug. 26, 1901. An arc lamp having a bi-pass around the regulating coil and a magnet of shorter time-constant than the coil responsive to the lamp current to control the same.

727,701. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 31, 1897. (See page 887.)

727,702. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, of New York, N. Y. App. filed December 13, 1899. (See page 887.)

727,703. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, of New York, N. Y. App. filed December 13, 1899. (See page 887.)

727,704. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, New York, N. Y. App. filed March 3, 1900. (See page 887.)

727,713. MEANS FOR ACCENTUATING ELECTRICAL CONTACTS; Elihu Thomson, Swampscott, Mass. App. filed Sept. 29, 1900. Mechanical and electrical devices for performing the function indicated by the title.

727,714. ELECTRIC ARC LAMP; Elihu Thomson, Swampscott, Mass. App. filed Oct. 26, 1901. An extra coil sensitive to fluctuations is utilized to produce a prompt and vigorous actuation of the clutch.

727,756. DEVICE FOR REINSULATING ELECTRIC AND AERIAL TELEPHONE OR OTHER CABLES; John Daggett, of Elyria, Ohio. App. filed Nov. 14, 1902. (See page 887).

727,763. ELECTRICAL SWITCHBOARD; Edward B. Ellicott, Chicago, Ill. App. filed April 26, 1901. Details.

727,764. ELECTRICAL PROTECTIVE DEVICE; Edward B. Ellicott, Chicago, Ill. App. filed Dec. 17, 1901. Details of a spring held plunger which is released by an electro-magnet and permitted to make a long movement in breaking the circuit.

727,792. PRODUCTION OF PERMANGANATES; Wilhelm Hickman, Frankfort-on-the-Main, Germany. App. filed March 3, 1903. A process for producing other permanganates than those of potassium and sodium.

727,801. TELEPHONE CALL-ANNUNCIATOR; George K. Jackson, of Reece, Kan. App. filed Aug. 5, 1902. (See page 887.)

727,813. ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES; Pierre Lederlin, Chedde, France. App. filed July 11, 1902. A method for the manufacture at a high constant yield of chlorates and perchlorates by the electrolysis of a chloride solution with the previous addition of a corresponding neutral chromate, consisting in maintaining the electrolyte during the electrolysis in a non-alkaline state by the addition of hydrochloric acid.

727,828. ELECTRIC TIME SWITCH; Myron A. Nickerson, Canton, N. Y. App. filed Jan. 28, 1903. Details.

727,829. CABLE TERMINAL; Joseph J. O'Connell, Chicago, Ill. App. filed Oct. 13, 1902. The conductors at the end of the cable are returned on the outside thereof and covered by a cap, the space between the cable end and the cap being sealed with a suitable insulation.

727,842. CEILING OR WALL BOX; James T. Robb, Brooklyn, N. Y. App. filed Nov. 12, 1902. The box has a tapering nipple in which a wedge-shaped head engages, insulating material being interposed between the head and nipple.

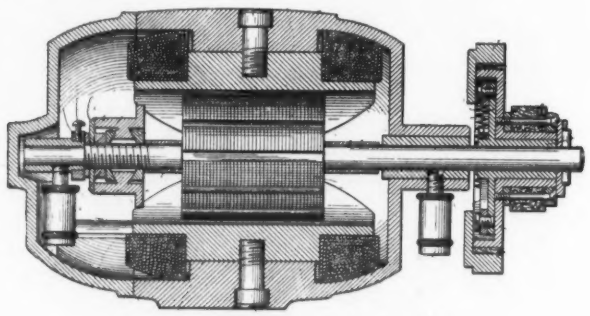
727,848. APPARATUS FOR BOILING BY ELECTRICITY; Robert C. Sayer, Bristol, England. App. filed June 25, 1900. The fluid is supplied to an open vessel situated within a closed vessel and is there heated by electrodes supplied with current automatically regulated by the pressure in the vessel.

727,865. GROUND DETECTOR FOR ELECTRIC CIRCUITS; Thomas W. Varley, New York, N. Y. App. filed Dec. 7, 1901. In connection with the supply circuit of a distribution system there are used means for deriving a local high resistance grounded circuit, means for indicating the flow of current from any ground portion of the system through said grounded circuit and means for transmitting and receiving signals through the circuit thus established.

727,870. INTERMITTENT AUTOMATIC SWITCH; Henry Wolf, Jr., Cincinnati, Ohio. App. filed Dec. 22, 1902. A quick-break electro-magnetic switch.

727,889. ELECTROLYTIC APPARATUS; Frank J. Briggs, Everett, Mass. App. filed May 21, 1902. Diffusion of the liquids in the different compartments by leakage is overcome by the employment of a pair of floating dialyzers practically independent of each other, but operating with relation to each other.

727,996. ELECTRIC PUSH BUTTON; John Y. Parke, Philadelphia, Pa. App. filed Jan. 27, 1903. The contacts co-operating with a number of buttons on a single plate are mounted on a post of insulating material fixed to the back of the plate.



727,568.—Dynamo Electric Machine.

728,015. INSULATING JOINT; James T. Robb, New York, N. Y. App. filed Dec. 4, 1902. A modification of No. 727,842.

728,017. REFRIGERATOR; John Rossi, Joliet, Ill. App. filed Jan. 12, 1903. The circuit of a lamp in the refrigerator is controlled by the latch on the door.

728,023. METHOD OF ELECTRIC WELDING; Joseph Schurek and Franklin B. Giesler, Milwaukee, Wis. App. filed March 31, 1900. For welding joints of different area in the same ring or body, the surfaces of one joint are held together while the other is being welded and thereafter the first point is welded.

728,034. REGULATOR FOR ELECTRIC CURRENTS; Thomas Spencer, Philadelphia, Pa. App. filed Dec. 16, 1901. A swinging solenoid and a fixed core, the relative positions of which determine the impedance of the coil which is used for regulating purposes.

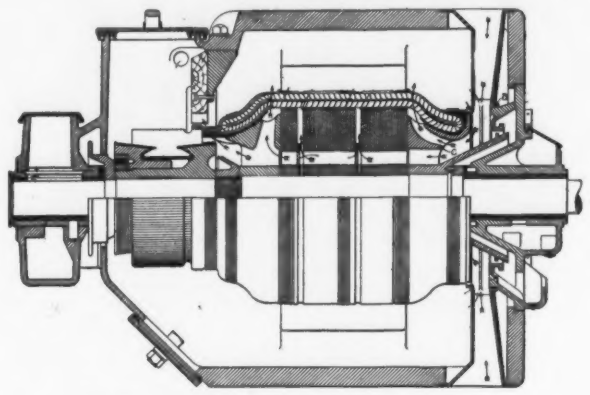
728,038. ALTERNATING CURRENT ELECTRIC MOTOR; Bernard A. Stowe, Cleveland, Ohio. App. filed July 12, 1902. Two coils disposed in inductive relation and connected in series in such way that the currents flow therein in opposite directions in connection with a low resistance conductor shunting one of the coils to prevent sparking.

728,039. ELECTRIC MOTOR; Bernard A. Stowe, Cleveland, Ohio. App. filed July 24, 1902. A modification of the preceding patent.

728,060. SWITCHBOARD INCANDESCENT LAMP; Allen D. Whipple, Chicago, Ill. App. filed Jan. 27, 1902. An insulating cap is cemented to the end of the lamp to protect the terminals.

728,076. GALVANOMETER; André Blondel, Paris, France. App. filed Jan. 3, 1901. The invention essentially consists in the employment of very thin and narrow bands of iron on which a mirror is secured, the bands being stretched on a support immersed in an oil containing case.

728,092. CONNECTOR FOR ELECTRICAL BATTERIES; William Rowland Edwards, Weybridge, England. App. filed March 17, 1903. A washer is inserted between the clamping surfaces to prevent access of corrosive materials to the inner parts of the connector.



727,685.—Cooling Dynamo Electric Machines.

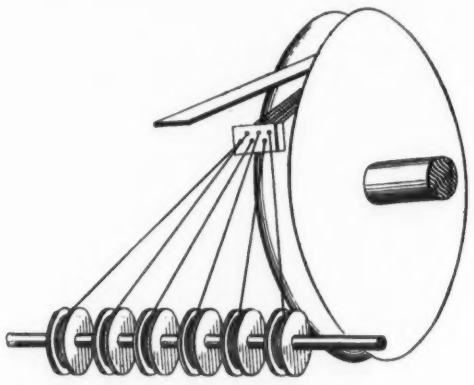
728,119. AUTOMATIC ELECTRIC CHAIN WELDING MACHINE; Carl A. Weuenberger, Biel, Switzerland. App. filed Aug. 28, 1902. When the welding heat has been attained and the ends of the link have been amalgamated by the pressing jaws, this pressure is made use of to effect the return of the electrodes to their position of rest and bring about the further sequence of processes.

728,134. LOCK; Christopher J. Roach, Hartford, Conn. App. filed Oct. 2, 1901. Devices whereby the opening of several mail boxes embraced in a circuit is dependent upon the proper successive operation of each.

728,147. TELEPHONE SELECTING DEVICE; William D. Watkins, San Jose, Cal. App. filed Dec. 2, 1901. (See page 887.)

728,152. INSULATING MEANS FOR ELECTRICAL APPARATUS; Asa F. Batchelder, Schenectady, N. Y. App. filed Sept. 3, 1901. An insulating sleeve is interposed between a pin and the walls of an orifice to obtain a driving fit between the parts which are at the same time insulated.

728,161. COMBINED TELEPHONE AND FIRE-ALARM SYSTEM; William Livingston Denio, of Rochester, N. Y. App. filed May 9, 1902. (See page 887.)



728,183.—Process of Winding Electrical Coils.

728,162. TELEPHONE; William L. Denio, of Rochester, N. Y. App. filed Feb. 6, 1903. (See page 887.)

728,164. SIGNAL CONTROLLING SYSTEM FOR ELECTRIC RAILWAYS; George Gibbs, New York, N. Y. App. filed May 22, 1902. To prevent excessive draughts of current from a sub-station of the road due to the practically simultaneous movement of an abnormal number of trains that may have been held up or delayed, the clearing of the signals is made dependent upon the amount of current drawn by the trains.

728,165. SIGNALING APPARATUS FOR TELEPHONE LINES; Fred E. Green, Newburyport, Mass. App. filed Jan. 2, 1902. (See page 887.)

728,183. PROCESS OF WINDING ELECTRICAL COILS; Richard Varley, Providence, R. I. App. filed Feb. 4, 1903. A process of coiling ribbon wire consisting in interposing a mechanical separator between the turns at the time of winding and afterwards removing the mechanical separator and substituing permanent insulating material, preferably of such nature as to become enamel after baking.